

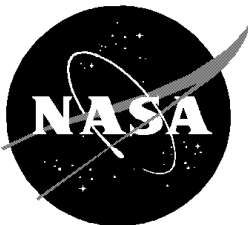
# Instrumentation and Communications Officer (INCO) Console Handbook

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Systems Division  
Communications and Data  
Systems Branch

Rev F, PCN-15  
November 4, 2002

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National Aeronautics and  
Space Administration

Lyndon B. Johnson Space Center  
Houston, Texas

MISSION OPERATIONS DIRECTORATE

INSTRUMENTATION AND COMMUNICATIONS OFFICER (INCO)  
CONSOLE HANDBOOK

REV F, PCN-15

November 4, 2002

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**TITLE**

INSTRUMENTATION AND COMMUNICATIONS OFFICER (INCO)

**PRIMARY INTERFACE**

Reports to flight director

**LIST OF DUTIES AND RESPONSIBILITIES**

Serves as flight control room (FCR) communications system engineer.

- A. Controls the communications and instrumentation systems via command.
- B. Analyzes and evaluates communications and instrumentation systems performance.
- C. Keeps the flight director abreast of communications and instrumentation systems status and of invocation of Flight Rules and provides him with necessary evaluations and recommendations pertaining to anomalies.
- D. Monitors circuit performance and takes necessary action to ensure adequate circuit quality for the accomplishment of the mission.
- E. Supervises performance of communications and instrumentation systems malfunction procedures and recommends corrective action or alternative action, as required, to include mission termination in accordance with mission rules.
- F. Directs the activities of communications and instrumentation support personnel located in the multipurpose support room (MPSR).
- G. Directs the operations support team (OST) to configure the space tracking and data network (STDN)/tracking and data relay satellite system (TDRSS) sites to keep them compatible with the vehicle communications system.
- H. Monitors and assists in the direction of Mission Control Center (MCC) pad support activities.
- I. Prepares and/or compiles and maintains logs pertaining to communications and instrumentation system performance.

## TITLE

RF COMMUNICATIONS OFFICER

## PURPOSE

To define the duties and responsibilities of the RF Comm officer.

## GENERAL

The RF Comm officer is responsible for supporting the FCR INCO in the monitoring, evaluation, and detailed analysis of spacecraft communications system activities for all flight phases.

## SPECIFIC DUTIES AND RESPONSIBILITIES

- A. Monitors comm systems performance and reports any off-nominal conditions to the INCO immediately. Also, performs all required specialized analysis of comm systems.
- B. Performs trend monitoring of comm systems, mainly Ku-band temperatures, for proper heater cycling verification.
- C. Analyzes and predicts Ku-band and S-band coverage and recommends systems configurations in response to the expected coverage.
- D. Builds command loads (TDRS STATE VECTORS, MRTC's, SPC's, MSPC's, TEC's, SSPC's, MSSPC's, and TMBU's), as required for comm systems and Spacelab systems management.
- E. Interfaces with COMMAND personnel to configure/manage the comm network (STDN/TDRSS/SGLS) and keep it compatible with the vehicle configuration.
- F. Interfaces with customer support personnel (P/L MPSR, CSR, etc.), as required.
- G. Supplies recommendations to the INCO in response to comm systems degradation or malfunction. This includes flight rule impacts and "next failure" considerations, as well as anomaly inputs and MER CHIT's, as required.
- H. Provides INCO with comm systems "GO/NO GO" recommendations at various predetermined times throughout the mission.
- I. Maintains an accurate mission log (per FCOH standards) of all comm systems activities.
- J. Supports the INCO during execute package generation for all comm related inputs. This includes Failure/Impact/Workaround (F/I/W) inputs and review of the package for uplink.
- K. Provides leadership for the entire MPSR team. This includes managing the MPSR in an effective, proper, and appropriate manner.
- L. Participates in vehicle/ground interface compatibility tests, as required.
- M. Provides specific systems expertise for the following:
  - 1. S-band PM, including antennas and COMSEC
  - 2. Data Processing System (DPS), as it affects command capability, antenna selection, and other comm systems operations

3. Ku-band comm and radar operations
4. Ultrahigh frequency (UHF) including antennas
5. Audio (ACCU's, ATU's, WCCS, EVC's, and "loose" comm gear)
6. Ground control interface logic (GCIL)
7. CCTV
8. SSOR

## TITLE

INSTRUMENTATION OFFICER (INST)

## PRIMARY INTERFACE

Reports to instrumentation and communications officer (INCO)

## LIST OF DUTIES AND RESPONSIBILITIES

The INST is responsible to the INCO for the monitoring, evaluation, and detailed analysis of spacecraft instrumentation system activities during the countdown and flight timeframes. System evaluation is predicated on flightcrew safety and the accomplishment of mission objectives. Specific duties and responsibilities are listed below.

- A. Based on detailed system analysis, recommends appropriate action to the INCO in case of system malfunction or degradation of the operational instrumentation: dedicated signal conditioner (DSC), operational instrumentation (OI) multiplexer/demultiplexers (MDM), pulse code modulation master unit (PCMMU), modular auxiliary data systems (MADS)/orbiter experiments (OEX), payload data interleaver (PDI), payload signal processor (PSP), payload interrogator (PI), and the orbiter interface unit (OIU). During specified flights and phases, the INST will also be responsible for the operational (OPS) and payload recorders.
- B. Provides spacecraft systems "GO/NO-GO" recommendations to the INCO at various predetermined times throughout the mission.
- C. Reports system deviations from normal operation and mission rule impacts to the INCO.
- D. Provides amplifying information to be relayed to the flightcrew when systems anomalies affecting the flight occur that are not indicated by orbiter displays.
- E. Provides specialized analysis of all mission operational instrumentation data flow. Is also responsible for the table maintenance block update (TMBU), variable parameters, telemetry format loads (TFL's), decom format loads (DFL's), fetch pointer memory (FPM) updates, and contingency PSP configuration messages.
- F. Prepares special trend and chart displays for contingency problems.
- G. Prepares mission logs to document the performance of the orbiter instrumentation system.
- H. Participates in alternate flight plan generation from the instrumentation aspect.
- I. Participates in vehicle/ground interface compatibility checkouts.

## TITLE

### LEAD INCO DUTIES AND RESPONSIBILITIES

#### GENERAL

The INCO group lead assigns senior members of the INCO group to plan, organize and document the activities before, during, and after the flight that affect the shuttle communications systems. The following list is a guideline for the lead INCOs to help in their planning for each flight.

#### PREMISSION DUTIES AND RESPONSIBILITIES

- A. Gather, review, and retain pertinent information describing the unique characteristics and payload manifest for that flight; for example
  - 1. Flight requirements document (FRD) at <http://sspweb.jsc.nasa.gov/pils/nsts.cfm>
  - 2. Payload integration plan (PIP) and PIP Annexes at <http://sspweb.jsc.nasa.gov/pils/nsts.cfm>, interface control documents (ICD's), schematics at <http://fs01jscsds.unitedspacealliance.com/>, cargo systems manuals, Cargo Integration Review (CIR) drawings, etc., that help describe the payloads and their interfaces with the orbiter communications and data systems.
- B. Coordinate with the lead Flight Director, lead Ground Controller (GC), lead Payloads, lead Flight Activities Officer (FAO), and other lead operators, as required, to resolve:
  - 1. Flight rule questions
  - 2. Comm related detailed test objective (DTO) questions and procedures
  - 3. TDRS/GSTDN/RTS site support plan
  - 4. Non-standard console operating procedures affecting communications and data flow
  - 5. Ku-band radiation constraints
  - 6. CCTV usage questions
  - 7. Payload communications systems operations and malfunction procedures
  - 8. Joint Operations procedures
- C. Represent the group at flight rule reviews, Payload Operations Working Group (POWG's) (for payloads interfacing with orbiter comm and data systems), Flight Operations Reviews (FOR), Operations and Maintenance Instruction (OMI) reviews, and other meetings requiring INCO participation.
- D. Prepare and input 482's, as required, to ensure that the flight data file (FDF) is current and complete.
- E. Provide flight readiness review (FRR) inputs, including flight-unique launch commit criteria (LCC) to the Division Office on request, per the master procedure located at <http://mod.jsc.nasa.gov/df/masterlist/df07.doc>. The template file for generating the INCO FRR is located on the [DF TA homepage](#). These inputs include but are not limited to:
  - 1. Anomalies and equipment replacements
  - 2. Significant configuration differences (since last flight)
  - 3. Significant flight data file changes
  - 4. Significant flight rules/LCC changes

5. Significant operational maintenance requirements and specifications document (OMRSD) waivers for the flight
- F. Provide Certification of Flight Readiness (CoFR) (template located on the [DF TA homepage](#)) inputs to the Division Office on request. These inputs include but are not limited to:
1. MCC team certification status
  2. MCC critical processor certifications
  3. LCC changes since FRR
  4. Mandatory instrumentation list (MIL) changes
  5. CIL/Hazard change impacts
  6. Assigned level 2 actions
  7. Previous flight's anomaly resolutions and impacts
  8. Pre-flight anomaly impacts and listing of still open anomalies
  9. Operational workarounds or new operations
  10. Shuttle/ISS Joint Operations problems that have not been resolved
  11. Cargo integration documentation problems that have not been resolved
  12. Command procedures problems that have not been resolved
  13. Flight requirements document problems that have not been resolved
- G. Coordinate the support for any shuttle mission simulator (SMS) integrated load checkouts (ILC's), flight specific simulations, terminal countdown demonstration tests (TCDT's), end-to-end tests, and other unique interface tests, as required.
- H. Conduct a pre-SIM-start training session to share with the INCO group the features and problems to expect during simulations and flight.
- I. Conduct a Preflight Tag-up with group members and other interested parties, to resolve any open items, ensure a common understanding of console procedures to be used during that flight and review any changes to the INCO planning memo since the final version was published.
- J. Publish the required operations and constraints memo (called INCO Planning Memo) per SCP 1.8  
Preliminary version before L-3 months or before start of flight specific simulations  
Final version before L - 2 weeks.
- K. Identify and report any major open issues to the group lead for aid in resolution.
- L. Publish any notes of interest to the group, as required.
- M. Direct the lead COMM and INST assigned to that flight, as required, to assist in completing any of the above tasks. Other team members on that flight may be requested to assist in resolving action items as well. Specifically coordinate the development of flight-unique command loads (e.g., PSP configurations, DFL's, TFL's, etc.), Ku-band beta angles, etc.

**MISSION DUTIES AND RESPONSIBILITIES**

- A. Resolve any issues among teams regarding console operations, as appropriate.
- B. Ensure that required data is retained for the postflight records.
- C. Ensure that the group lead is informed of any major systems anomalies.

**POSTMISSION DUTIES AND RESPONSIBILITIES**

- A. Publish the postflight report.
- B. Complete the Mission Support Evaluation
- C. Lead a mission debriefing with group members.
- D. Maintain cognizance of the resolution of any INCO in-flight anomalies. Provide data to aid in resolution, as required.
- E. Gather and retain postflight records in accordance with group policy.
- F. Provide a quick look debriefing to the division staff upon request.
- G. Provide lessons learned briefing to DA8 upon request.

## TITLE

LEAD RF COMMUNICATION OFFICER DUTIES AND RESPONSIBILITIES

## PURPOSE

To define the procedure used by the lead RF Comm to prepare for each mission.

## GENERAL

The RF Comm Officer assigned to the lead flight control team will assume the duties of lead RF Comm to facilitate preflight planning and ensure all required information is available on console. This procedure has been written as a guideline for the lead RF Comm.

The RF Comm should attend the Payload Familiarization meeting, Orbiter Flight Techniques Panel (OFTP) meetings, Payload Operations Working Group (POWG) meetings, and any other appropriate meetings to maximize familiarity with the objectives and challenges of the mission. The RF Comm should also participate with the lead INCO in all premission activities.

## PROCEDURE

- A. Obtain the radio frequencies for all payloads. The frequencies for each specific payload can be found in the Payload Integration Plan (PIP) Annex 1 and the Cargo Systems Manual (CSM). A PIP and CSM are created for each payload. The instrumentation or payload officer may also be able to supply frequency data. For help converting the frequency to PI channel, reference SCP 3.96. Use this information along with the cargo radio frequency constraints from the Flight Requirements Document (FRD) to determine the orbiter RF plan (S-band PM, FM and Ku-band).
- B. Check the FRD to see if the following items are manifested.
  1. CCTV camera types and locations
  2. Orbiter VCR's
  3. WCCS
  4. Payload recorder
  5. SSOR
  6. Comm related DTO/DSOs
  7. VHF
  8. WVS
- C. Review the cargo integration drawings to verify the PDIP connections and the impact to Ku-band interfaces.
- D. Review the OMI for comm activation changes. Notify comm activation team of the changes.
- E. Review the DTO's and DSO's for any comm impacts (Ku-band, PDIP, etc).
- F. Evaluate planned usage of the Ku-band system with regard to published constraints. Pay particular attention to conflicts between Radar and Comm usage and possible violations of any Flight Rules relating to Ku (such as radiation constraints, EVA constraints, etc).
- G. Evaluate the planned usage of the OPS and P/L recorders. Check TDRS S-band coverage to determine OPS recorder record requirements. Also, check Payload recorder record requirements. Check Ku-band coverage to determine Ku dump availability. Use this information to identify any ground site requirements for dump support.



- H. Assist the Lead INCO with coordination of TDRS handover requirements. Work with Payloads, FAO, GC, and Command to determine the plan. Command will submit the preflight TDRS schedule to Goddard about L-2 weeks, at the latest.
- I. Evaluate planned TV downlink (PAO events, etc.) and verify no conflicts with Ku usage/coverage, VTR dumps, etc.
- J. Determine if any off-nominal video or audio equipment will be flown (check with Crew Systems, Photo/TV personnel). Verify complete video configuration for the flight. Determine crew audio configuration plan.
- K. Compile the information from blocks A through J into a Comm Summary Sheet for your flight. Give all INCO's and RF's a copy of this sheet. This information will assist the lead INCO with the task of preparing the COMM memo.
- L. Provide the Lead INCO with any specific changes and procedures you want to go into the following documents for his review. Provide this information to the appropriate book manager after INCO's review for inclusion into the earliest possible revision of these books. Ensure that your inputs are properly incorporated. Inputs can be made to FDF (in increasing order of difficulty) verbally before the FOR (~L-4 months), by DN during the FOR, and thereafter by 482 or flight note.
  - 1. Orbit Ops C/L, Flight Supplement
  - 2. Post Insertion C/L
    - Verify heaters turned on for nonstandard PLB cameras (such as Keel and Truss cameras).  
Otherwise verify heater callouts removed if they do not apply.
  - 3. Contingency D/O Prep
  - 4. Rendezvous
  - 5. Deorbit Prep
  - 6. Deploy C/L (if used)
  - 7. Ascent C/L (switch configurations)
- M. Review the following books.
  - 1. Post Insertion Checklist: Verify proper configurations.
  - 2. Flight Rule annex: Verify rules have proper values and rational.
  - 3. Deploy C/L: Verify proper configurations. Do not forget about contingency deploys in this review. Ensure the RF constraints are not violated.
  - 4. Flight Plan: Verify TDRS handovers and proper configurations. Do not forget about contingency deploys in this review. Ensure the RF constraints are not violated.
  - 5. Operations Support Timeline (OST), if available: Same as no. 4.
  - 6. JOIP procedures RF/INCO may be involved in.

- N. Build the following loads on the workstation.
  1. Verify the proper BFS antenna management site inhibit TMBU's are built (should be in appropriate directory).
  2. Verify the proper SPC's are built (should be in appropriate directory).
  3. Verify the proper Ku-band TMBU's are built (only a select few are prebuilt in the CMD SVR).
- O. Flight Documentation Checklist. Use this checklist as an aid to ensure you have completed all actions required by this SCP. Completion time: 1 week prior to first sims (~L-3 months), desired, and no later than 1 week prior to flight.
- P. Study! You are the RF expert for your mission. Be as prepared as possible and strive to prepare the "RF/INCO team." Arrange for an RF meeting before the sims or flight, if necessary. During the mission, lead the RF team. Ensure that nominal ops are accurately captured in logs and miscellaneous documentation; push troubleshooting, as required. Strive for a thorough, complete, logical, and creative approach to operating and troubleshooting your systems.
- Q. Postflight, compile a list of any RF lessons learned and distribute to the rest of the section. Submit any documentation updates needed. Provide data to the Lead INCO for inclusion in the Post Flight Report.

Document /review	SCP item	Target completion date (L - )	Actual completion date	On-console date	√
CARGO FREQS	A	4 months		N/A	
FRD CHECK	A,B	3 months			
CARGO INTGR DRWGS	C	6 months		N/A	
OMI/COMM ACT	D	1 months			
TDRS H/O PLAN	H	1 months			
MAKE RF SUMMARY	K	4 months			
PROCS & MALFS	L	6 months		N/A	
BOOK REVIEW	M	3 months		N/A	
COMMAND LOADS	N	4 months			
DOCUMENTATION UPDATES	Q	Landing + 1 month			

## TITLE

LEAD INSTRUMENTATION OFFICER DUTIES AND RESPONSIBILITIES

## PURPOSE

To define the procedure used by the lead INST to prepare for each mission.

## GENERAL

The Instrumentation Officer assigned to the lead flight control team will assume the duties of lead INST to facilitate preflight planning and to ensure all required information is available on console. This procedure has been written as a guideline for the lead INST.

The INST should attend Orbiter Flight Techniques Panel and Payload Operations Working Group (POWG) meetings to maximize familiarity with the objectives and challenges of the mission. The INST should also participate with the lead INCO in the Flight Operations Review (FOR) process, submitting discrepancy notices (DNs), and discussing and resolving as many issues as possible.

## PROCEDURE

- A. Obtain the entire set of TFL/DFL/FPMs from MAST II, the reconfiguration manager, or the Payload Management (PM) FSR. Based on the information obtained, provide to the lead INCO a first draft of the TFL tables for the Orbit Ops C/L, using the documents tfl\_dfl.doc, dumpcomp.doc, and downlist.doc. located on the file server in the s:..\\df24\forms\fd\orbt\_ops directory. Use these files and SCP 3.83 to complete the table. Save the changes you make to a file in your own directory. Screen the TFL/DFL information for toggle buffer memory overlap, LDR OI, LDR SM downlist, and LDR GNC downlist. Tables 5-3 and 5-4 of the PM FSR should be referenced for this information. For flights requiring complex TFL plans, document each discipline's requirement. Reference Flight Rule A2.1.3-30 for Orbiter On-Orbit High Data Rate Requirements.
- B. Check the Flight Requirements Document (FRD) to see if the following items are manifested.
  1. OIU
  2. Spare PDI
  3. PI
  4. ERPCL
  5. PGSC interface with OI/PL telemetry
  6. Payload Recorder
  7. INST related DTO/DSOs
- C. Obtain the PI receive and transmit frequencies for all payloads. The frequencies for each specific payload can be found in the Payload Integration Plan (PIP) Annex 1 and the Cargo Systems Manual (CSM). A PIP and CSM are created for each payload. The payload officer may also be able to supply frequency data. For help converting the frequency to PI channel, reference SCP 3.96.
- D. Get the following information from the Command and Data (C&D) Annex (PIP Annex 4), or the PM FSR, for each payload on your flight (including secondary payloads).
  1. PSP configuration message(s) (C&D Table 19) sec. 19.0001 (compare with PM FSR table 7.17.1, annotate table with conversion to actual rates and connections, including name of payload for each configuration)
  2. Payload telemetry and command data rates (C&D Annex table 7)

- E. Using PIP Annex 1, the CSM, the Payload Systems Data and Malfunction FDF, or the applicable source for each payload, make an integrated payload schematic, showing command and telemetry data paths, rates, and troubleshooting information, such as MAL procedures, IFMs, and flight-specific changes.
- F. Compile the information from blocks A through E into an INST memo and an INST summary sheet (cue card) for your flight. Give all INCOs and INSTs a copy of this memo and sheet. This information will assist the lead INCO with the task of preparing the COMM memo. Put documents obtained into notebooks for all simulations and the flight.
  - 1. PM FSRs, SM FSRs, JOIPs, C&D Annexes, PIP annexes, and CSMs have dedicated binders at the console.
  - 2. Include an INST book containing copies of the COMM and INST memos, OEX Plan, FRD, OST, and any flight-specific INST information, such as the PSP configuration table, which was annotated with conversions to actual rates and connections. Helpful diagrams, such as cue cards, integrated payload schematicsshould also be inserted into the outside cover of the book (under clear plastic).
- G. Provide the lead INCO, the A/E INCO, and the A/E INST with the ascent TFL/DFLs for inclusion in the prelaunch TFL/DFL requirements memo. Make sure the information sent to KSC reflects your desires for TFLs and DFLs from prelaunch through postinsertion because the crew will not be able to reconfigure the PCMMU/PDI until they start into the Post Insertion Checklist. If there are no PDI requirements for ascent, have them load the first on-orbit configuration used.
- H. Provide the lead INCO with the specific TFL/DFL configurations, and any unusual malfs you want to go into the following documents for review. Provide this information to the appropriate book manager after INCO's review for inclusion into the earliest possible revision of these books. Ensure that your inputs are properly incorporated. Inputs can be made to FDF (in increasing order of difficulty) verbally before the FOR (~L - 4 months), by DN during the FOR, and thereafter by 482 or flight note.
  - 1. Orbit Ops C/L, Flight Supplement
  - 2. Post Insertion C/L
  - 3. Contingency D/O Prep
  - 4. Deorbit Prep
  - 5. Deploy C/L (if used)
  - 6. Ascent C/L (switch configurations)
  - 7. Payload Ops C/L (for proper payload comm procedures; also, to ensure that the deactivation procedures put the back panel in the Deorbit Prep Entry Switchlist/Verification configuration)
- I. Use the MADS/ OEX data requirements information from the FRD to create a MADS or OEX Operation Plan. For OV-102 flights, contact the OEX representative and the section's OEX representative 2 months before the flight to schedule an OEX command plan meeting. Use the SCP 3.31 command plan as a baseline. For OV-102 flights with OARE manifested, the OEX command plan should include the OARE plan. Ensure that the PLR is powered on in the documentation, if applicable.

- J. Review the following books.
1. Orbit Ops C/L: Verify TFL/DFL/FPM information.
  2. Post Insertion Checklist: Ensure the TFL/DFL load procedures are correct.
  3. Deploy C/L: Ensure the PI, PDI, and PSP procedures are correct.
  4. Flight Plan: Ensure the activities called out can be supported by the TFL/DFL loaded at the time; for example, FCS C/O in GNC OPS 8 requires a high rate GNC window, as in TFL 161. Do not forget about contingency deploys in this review.. Ensure the PI/FM constraints are not violated.
  5. Operations Support Timeline (OST), if available: Same as no. 4 above.
  6. JOIP procedures with which INST may be involved.
- K. Review all books that contain INST malfs (the big malf book, any P/L malf books, etc.), and check that all MSIDs or measurement names called out actually come through the MDM/DSC referenced in the malf. Also, look for procedures that may leave the P/L COMM switch in PNL while reconfiguring, including its possible impacts.
- L. Build the following loads, using INST CMD BUILD on the workstation.
1. TFL/DFL loads for the flight (procedure in SCP 3.9)
  2. PSP Configuration Messages, with a dummy command load for each configuration (procedure in SCP 3.36)
  3. Any required payload throughput loads (procedure in SCP 3.38) which may include OIU
- M. Ensure the following are on console (and know how to use them).
1. Master Measurements List (MML) - This is a TFL, DFL, and FPM listing that contains actual listings for TFLs, DFLs, and FPMs. This can be found online on the P51.KSC web site.
  2. MAST II database (CD ROM).
  3. PCMMU SM Bypass Bit Definitions hard copy and CD ROM. Select **Start**, select **MOD Server Menu**, select **MOD-Wide Applications**, click on **DXR**
    - a. Select **File**, click on **Open**, go to **My Computer** to see all the drives
    - b. Install CD, with label (e.g., STS-077 FL, PASS, BFS, and MMU); wait until CD drive name updates; e.g., Sts077fl
    - c. Double-click on CD drive, double-click on top folder; e.g., Sts077fl, double-click on Pass, verify Files of type = **Reports**
    - d. Double-click on **Smpm.dat**, select **Page**, click on **Last Page**

- e. Use tool bar ⇐⇒ arrows to find last page of PCMMU bypass tables and record page number; e.g., 4866, then find first page of PCMMU bypass tables and record page number; e.g., 4847
  - f. Select **File**, click on **Print**, click on **Pages** button, add range of bypass tables; e.g., 4847-4866, click on **OK**
4. Instrumentation Program and Component List (IPCL), vols. I, II, and III
  5. PIP C&D Annex(es)
  6. MADS/OEX Data Plan (from K above)
  7. (If OEX used) SCM PROM listing
  8. PM FSR
  9. SM FSR
- N. Flight Documentation Checklist. Use this checklist as an aid to ensure that you have all actions required when this SCP is done. Completion time: 1 week prior to first sims is desired, but no later than 1 week prior to flight.
- O. Study! You are the INST expert for your mission. Be as prepared as possible and strive to prepare the "INST team." Arrange for an INST meeting before the sims or flight, if necessary. During the mission, lead the INST team. Ensure that nominal ops are accurately captured in logs and miscellaneous documentation and push troubleshooting, as required. Strive for a thorough, complete, logical, and creative approach to operating and troubleshooting your systems.
- P. Remove old simulation cmdtrk and dump files from the following directories: /users/inco/rw\_common/data/cmdtrk and /users/inco/rw\_common/dump. Be sure not to delete files of commands to the real vehicle; e.g., commands sent during pad test and COMM activation. Use the UNIX command `ls -al` to list all files in the directory and the dates the files were created. To delete files, use the UNIX command `rm`, followed by names of files to be deleted, in the following sample format: `rm 91cmdtrk.087 91cmdtrk.088 91cmdtrk.089` (to remove all three files). These files should be cleaned out before lift-off.
- Q. Submit a training roster for all INCO teams on completion of the flight. Forward the roster to DT65/Ginger Deans.
- R. Postflight, compile a list of any instrumentation lessons learned and distribute to the rest of the section. Submit any documentation updates needed. Provide data to the lead INCO for inclusion in the Post Flight Report. Remove documentation from console. Give documentation to be archived to the lead INCO and save the documents you feel will be helpful, such as the INST memo.

Document/review	SCP item	Target completion (weeks to launch)	Actual completion date	On-console date	√
PROCS & MALFS INPUTS	H	24		N/A	
TFLs/DFLs	A	16		N/A	
FRD CHECK	B	16		N/A	

Document/review	SCP item	Target completion (weeks to launch)	Actual completion date	On-console date	√
PI FREQS	C	16		N/A	
C&D ANNEX CHECK	D	16		N/A	
PIP ANNEX 1 CHECK	E	16		N/A	
MALF BOOK REVIEW	K	16		N/A	
MAKE INST SUMMARY	F	12			
ASC TFL/DFLs TO INCO	G	12		N/A	
BUILD INST LOADS	L	12			
P/L THRUPUT LOADS	L.3	12			
PCMMU BYP BIT DEF	M.3	12			
MADS/OEX PLAN	I	8		N/A	
MADS/OEX PLAN	M.6	8			
MML	M.1	2			
MAST D/B	M.2	2			
IPCL	M.4	1			
C&D ANNEX(ES)	M.5	1			
SCM PROM LISTING	M.7	1			
PM FSR	M.8	1			
SM FSR	M.9	1			
FLIGHT DOCUMENTATION C/L	N	1			
TRAINING ROSTER	Q	Landing + 1			
DOCUMENTATION UPDATES	R	Landing + 4			

**TITLE**

DATA COMMUNICATIONS OFFICER

**PRIMARY INTERFACE**

Reports to instrumentation and communications officer (INCO)

**LIST OF DUTIES AND RESPONSIBILITIES**

The data communications officer (DATA COMM) serves as a flight controller at the DATA COMM console in the multipurpose support room (MPSR) and is responsible to the flight control room (FCR) INCO for monitoring, evaluating, and performing analyses of spacecraft operational recorder system activities during the countdown and the flight. Flight crew safety and accomplishing mission objectives are the primary focus throughout the system analysis. Specific duties and responsibilities are as follows:

- A. On the basis of detailed system analysis of the operational flight recorders (solid state or tape), payload recorder (payload recorder responsibility may be handled by INST or RF COMM depending on the mission application), and frequency modulation (FM) system, recommends appropriate action to the INCO in case of system malfunction or degradation.
- B. Provides spacecraft systems GO/NO-GO recommendations to the INCO at various predetermined times throughout the mission.
- C. Reports system deviations from normal operation and mission rule impacts to the INCO.
- D. Provides information to be relayed to the flight crew when systems anomalies affecting the flight occur that are not indicated by the spacecraft displays.
- E. Prepares special trends and chart displays for contingency problems.
- F. Prepares and/or compiles mission logs as they pertain to the performance of spacecraft systems. Also maintains a detailed log on recorder operations that is used by each operator to enable systematic retrieval of recorded data.
- G. Participates in generating alternate flight plan from the recorder systems aspect.
- H. Performs appropriate recorder configuration for all phases of flight. On orbit, data only should be recorded during loss of communications periods, data and voice should be recorded during EVA (check preflight agreement on whether to dump LOS or all data and voice). Also, both recorders should record serial data during important burns and played back if necessary.

Tape Recorders: on ascent, OPS 1 should be configured to record parallel SSME data at 7.5 ips and OPS 2 should be configured to record serial data and voice.

Solid State Recorders: on ascent, SSR 2 should be configured to record parallel SSME and OD, and SSR 1 should be configured to record serial data and voice. Payload data recording, if required, will be addressed in mission specific plans.

- I. Verifies one recorder recording at all times to capture expected and unexpected loss of communication periods.
- J. Plays back (dumps) all data and voice recordings from ascent and entry and all loss of signal data recordings on orbit.



## TITLE

COMMUNICATIONS PLANNING MEMORANDUM DEVELOPMENT AND DISTRIBUTION

## PURPOSE

The Communications Planning memorandum is a compilation of information gathered from various official documentation for mission-specific requirements levied on the Instrumentation and Communications Officer (INCO) by various parties. It also contains mission-specific information necessary for mission success. As such, it becomes the guideline for the conduct of integrated simulations and real-time flight. The memorandum may be published in several phases, starting with a preliminary version and culminating with a final and a delta, if required, prior to launch.

## PROCEDURE

- A. The lead INCO primarily will gather and compile information from the following documents:
1. Flight Requirements Document (FRD)
  2. Payload Integration Plans (PIP) and their attendant annexes
  3. Payload Flight Software Requirements document (PL FSR)
  4. Systems Management Software Requirements document (SM FSR)
  5. Flight Rules (Generic)
  6. Flight Rules (Mission Specific Annex)
  7. Cargo integration drawings.
  8. All generic Flight Data File (FDF) books that have instrumentation and/or communications system requirements
  9. All mission-specific FDF books that have instrumentation and/or communications system requirements
  10. All Station Operations Data File (SODF) books that have instrumentation and/or communications systems requirements.
  11. Attitude Timeline
  12. Joint Operation Integration Procedures (JOIP)
  13. Launch Commit Criteria (LCC)
  14. Network Operations Support Plan (NOSP) and Integrated Support Instruction (ISI) modifications to the NOSP

Note that there are other official documents that may be generic or mission specific that have significant mission information. Listed below are some of these sources.

1. All Electronic Systems Test Laboratory (ESTL) reports on mission specific or generic testing.
2. All engineering evaluations on shuttle avionics capabilities and on mission-specific payload system characteristics and capabilities.

3. Any special testing performed by outside entities for a mission-specific payload.
- B. The lead INCO uses the last Comm memo from the previous flight of a similar payload as the basis for the new memo (e.g., last shuttle-ISS flight). The contents of the memo should contain the information outlined in paragraph C. below. If no similar memo exists, the memo must be created from scratch and should contain the material outlined in paragraph C.
- C. The contents of the INCO communications planning memorandum vary by mission and usually contain, at a minimum, the following information:
  1. Flight description and crew assignments
  2. Mission overview, including payload descriptions
  3. Ascent/entry and on-orbit S-band communications configurations
  4. Ku-band communications configurations
  5. Antenna Management plan
  6. Closed circuit TV (CCTV) systems plan
  7. Flight-specific panels and equipment (e.g., Computer Interface Panel, etc.)
  8. S-band frequency modulation system plan
  9. Ultrahigh frequency system and Space to Space Communications System (SSCS) plan
  10. Payload command plan and constraints
  11. Instrumentation and payload communication system (payload signal processor, and payload interrogator) plan
  12. Telemetry format load, decommutator format load, and fetch pointer memory load usage plan
  13. Orbiter communications adapter plan
  14. Operations, payload, and MADS recorder usage plans
  15. Assigned detailed test objectives and detailed supplemental objectives plan
  16. Ground site and tracking data relay satellite system (TDRSS) configurations
  17. Ground site and TDRSS scheduling

## **PUBLICATION SCHEDULE**

The publication schedule is adjusted for each mission, but generally falls into three publication dates.

- The preliminary memorandum is published between 3 to 4 months prior to launch and contains the information necessary to start integrated simulations.
- The final memorandum is published between 1 to 2 weeks prior to launch.
- From launch minus 7 days until launch, any significant changes are published as a delta to the document.

## **DISTRIBUTION AND DISTRIBUTION LISTS**

The distribution, as far as practical, will be done electronically. Printed copies will only be mailed to those people that specifically request a paper copy. Those people that request paper copies may not receive the deltas to the final document prior to launch. The distribution of the document is performed by the DF24/Comm Group lead in conjunction with the DF2/branch secretary.

There are two types of distribution lists: standard and mission specific. The standard distribution list is as follows: Mission Operations Director, Flight Director Office Chief, DF Systems Division Chief, DF2 Branch Chief, DF24 personnel, GC Group lead, GSFC Network Director, KSC Communications Group lead, KSC Instrumentation Group lead, MILA Site Director, OST Telcom Branch lead, OST Voice/Video Branch lead, and EV4/Avionics Integration personnel. Mission-specific distribution is as follows: mission crewmembers, all assigned Flight Directors, lead payloads officer, FAO officers, and the lead GC. The mission-specific list is supplied by the lead INCO to the group lead who helps the branch secretary distribute the memo.

**TITLE**

CONSOLE CUE CARDS

**PURPOSE**

To define the console cue cards used by the INCO team.

**GENERAL**

The Instrumentation and Communications Officer assigned to the lead flight control team will assume the responsibility for ensuring that only approved cue cards, as defined herein, of the latest issue will be placed under glass on each of the INCO team consoles prior to each flight.

**APPROVED CUE CARDS**

- A. Any part of a controlled document of the latest approved issue may be used as a cue card, provided that the document number, revision, and PCN (if any) are clearly marked.
- B. Any part of an uncontrolled document may be used as a cue card, provided that the document number, revision, and PCN (if any) are clearly marked and that the label in Figure 1.9-1 or facsimile thereof is copied or affixed to the cue card.

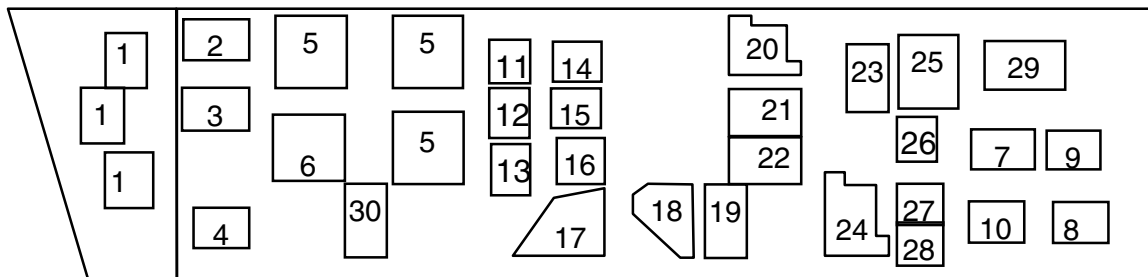


**Figure 1.9-1. Uncontrolled document label**

- C. Any part of this SCP may be reproduced and used as a cue card, subject to section A above.

**CURRENT CUE CARD CONFIGURATION**

- A. INCO console cue card layout, per Figure 1.9-2



**Figure 1.9-2. INCO console current cue card layout**

- 1. Parameters Listed According to MDM and DSC, SCP 3.101, pages 1, 2, and 3
- 2. MCC Access Control phone list; updates available from building 30S, room 3306
- 3. Avionics bay comm equipment, Figure 1.9-3

AV Bay 1	AV Bay 2	AV Bay 3A
ACCU 1&2 CIU PF1 PLR, MMU 1 PDI PCMMU 1 MDM&DSC OF1 FF1	PI 1&2 PSP 1&2 PF2 OPS 1&2, MMU 2 PI RW SW PCMMU 2 MDM&DSC OF2	UHF GCIL COMSEC 1&2 Ku EA1&EA2 FM XMTR 1&2 FM SPA 1&2* MDM&DSC OF3 FF3
Cabin	AV Bay 3B	NSP 1&2 XPNDR 1&2 PA 1&2 PRE AMP 1&2 AE 1&2* SW BEAM 1&2* FM ANT SW 1&2* SSOR
VSU/RCU/VPU* MDM OF4* OEX RCDR* ATU (ALL)* TV MON (ALL)* PDIP* OIU*	KuSP MTU	
JSC-12829, SCP 1.9 REV F, PCN-13		*Air cooled.

Figure 1.9-3. Avionics bay comm equipment

4. DSC BITE pattern by bus, Figure 1.9-4

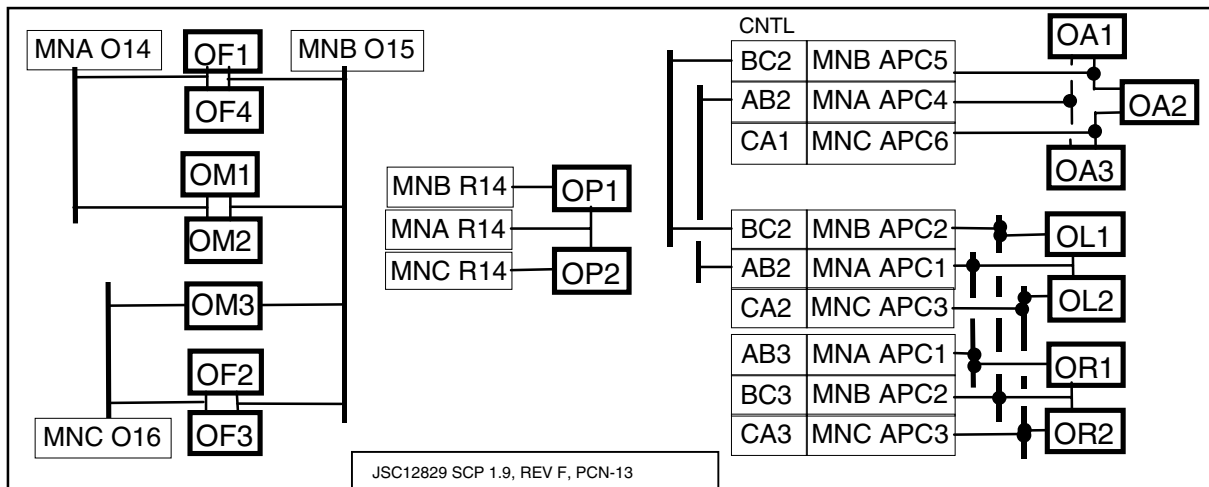
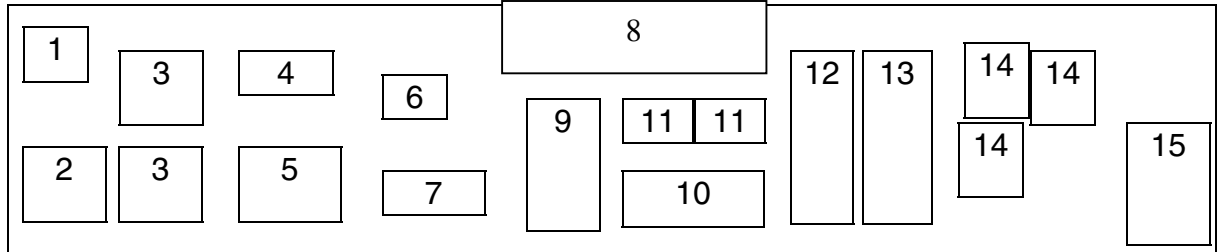


Figure 1.9-4. DSC BITE pattern by bus

5. Power bus tables, SCP 4.23, Tables 4.23-2 and 4.23-3
6. Orbiter Electrical Bus Loss Matrix
7. DPS Dictionary, SM 011, Antenna
8. DPS Dictionary, SM 062, PCMMU/PDI
9. DPS Dictionary, SM 001, DPS Utility
10. DPS Dictionary, SM 076, COMM
11. SSSH dwg. 20.1, sheet 2, panel L5
12. SSSH dwg. 20.1, sheet 2, panel R6
13. SSSH dwg. 20.1, sheet 4, panel O6
14. SSSH dwg. 20.1, sheet 4, panel O5
15. SSSH dwg. 20.1, sheet 4, panel O9
16. SSSH dwg. 20.1, sheet 2, panel C3
17. SSSH dwg. 20.2, sheet 1, panel A1U
18. SSSH dwg. 20.2, sheet 1, panel A1L
19. SSSH dwg. 20.2, sheet 1, panel A1R
20. SSSH dwg. 20.1, sheet 3, panel O14
21. SSSH dwg. 20.2, sheet 1, panel A2
22. SSSH dwg. 20.2, sheet 1, panel A3
23. SSSH dwg. 20.1, sheet 3, panel O15
24. SSSH dwg. 20.1, sheet 3, panel O16
25. SSSH dwg. 20.2, sheet 3, panel R14
26. SSSH dwg. 20.1, sheet 3, panel O17
27. SSSH dwg. 20.2, sheet 1, panel A7L, 102 only
28. SSSH dwg. 20.2, sheet 1, panel A6L, not 102
29. SSSH dwg. 20.2, sheet 1, panel A7U
30. CTVC (ITVC) Menu Ops Cue Card

B. COMM Support Console cue card layout, per Figure 1.9-5



**Figure 1.9-5. COMM Support Console cue card layout**

1. SCAN ZONES, one-of-a-kind hand-drawn graph
2. Flight Data File usage per mission phase, Shuttle Crew Operations Manual (SCOM), Section 3.5
3. Power bus allocation, SCP 4.23, Table 4.23-2
4. Orbit Pocket Checklist, TOC for COMM
5. Scan Zones, SODB, Figure 3.4.5.2-19
6. Antenna DSMs, Figure 1.9-6

DSM no. AE1 - AE2	Antenna
4676 - 4692	ULF
4677 - 4693	ULA
4678 - 4694	URF
4679 - 4695	URA
4680 - 4696	LLF
4681 - 4697	LLA
4682 - 4698	LRF
4683 - 4699	LRA
JSC-12829, SCP 1.9, REV F, PCN-13	

**Figure 1.9-6. Antenna DSMs**

7. Ku RADAR reference card, per Figure 1.9-7
8. Hardware Panel
9. Long Form MAL, TOC for COMM
10. Ku Self-test Data Blocks to the MDM, SB 10, Table 10-5
11. DPS Dictionary, SM 076, COMM; SM 2011, Antenna
12. Water Flow Distribution System for INST and COMM equipment, SB 20.2
13. AV Bay INST Equipment, SB 20-4, 20-5

14. Parameters listed according to MDM and DSC, SCP 3.101
15. INCO phone list

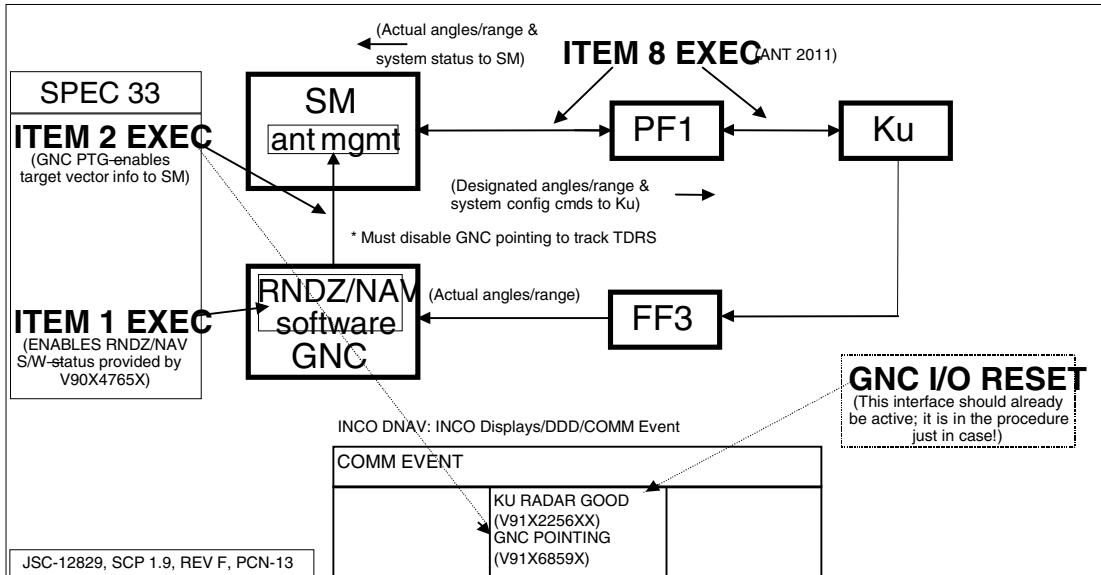


Figure 1.9-7. Ku RADAR reference card

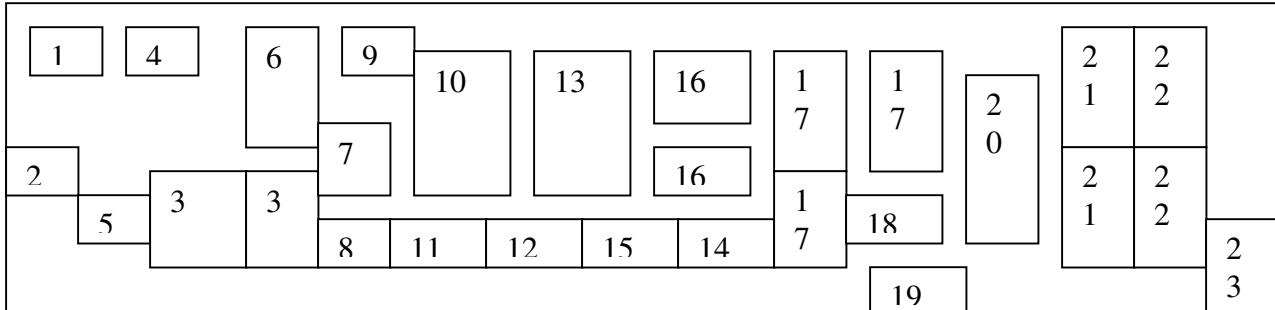


Figure 1.9-8. INST/DATA COMM Console current cue card layout

C. INST/DATA COMM Console current cue card layout, per Figure 1.9-8

1. DPS Dictionary, SM 062, PCMMU/PDI
2. AV Bay INST Equipment, SB 20-7
3. Avionics Bay Comm Equipment, Figure 1.9-3
4. GPC Dump/TFL Compatibility, SCP 3.83, Table 3.83-1
5. INST Start-Up Actions, per Figure 1.9-9.



<b>INST Start- Up Actions</b>
isp_channel (click on "Automatic")
Limit Manager (click on "Orbit")
Oimon 2
Training Roster
JSC-12829, SCP 1.9, REV F, PCN-13

**Figure 1.9-9. INST Start-Up Actions**

6. Long form MAL, TOC for INST
7. OI Electrical Summary Data, SB 26, Table 26-5
8. DSC BITE pattern by bus, Figure 1.9-4
9. Flight Data File usage per mission phase SCOM, Section 3.5
10. Power bus table, SCP 4.23, Table 4.23-2
11. LCC table from SCP 3.5
12. Discipline contacts and loops, per Figure 1.9-10.

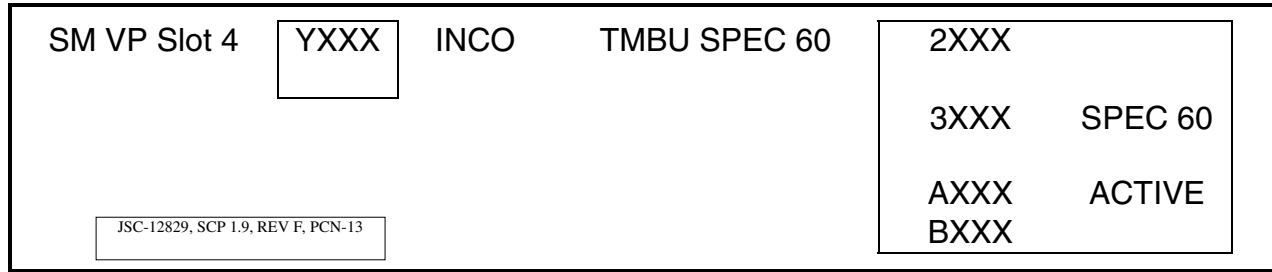
DISCIPLINE	FCR LOOP	MPSR LOOP	MPSR POSITIONS
EECOM	MOCR SYS	SSR-1*	THERMAL, LIFE SUPPORT
EGIL	MOCR SYS	SSR-1*	EPS
MMACS	MOCR SYS	IFM COORD*/SSR-1*	IFM, MECHANICAL
PROP	MOCR GNC/PROP	SSR-1*	OREO
PLO	PAYLOADS	INST COORD	PL DATA, PL SYS
BOOSTER	MOCR SPEC	BOOSTER MPSR	ME SUPPORT
DPS	MOCR DPS/CDMS	SSR-1*	DPS SUPPT, CDMS

\* Use multi-operator loop for initial contact, meet on INSTR COORD for extended conversation.

JSC-12829, SCP 1.9, REV F, PCN-13

**Figure 1.9-10. Discipline contacts and loops**

13. INST systems power buses, per Figure 1.9-12.
14. MCC Access Control phone list; updates available from building 30S, room 3306
15. DSC location on shuttle, SB 27, Figure 27-2
16. Orbiter Electrical Bus Loss Matrix, Assy Ops/5A.1/Fin, p 365
17. Parameters Listed According to MDM and DSC, SCP 3.101
18. SM VP Slots 4 and 5, Figure 1.9-11.



**Figure 1.9-11. SM VP slot 4**

- 19. BLDG 30 FAX (281) 483-4947
- 20. OPS Recorder table, percent tape vs. speed vs. time, per Figure 1.9-13.
- 21. OPS/PL Recorder Information SCP 3.26, pg 15-16
- 22. SSR Information, SCP 3.30, pg 11-12

	MNA O14	MNA R14	MNB O15	CNTL AB1	CNTL AB2	CNTL AB3	CNTL BC1	CNTL BC2	CNTL BC3	CNTL CA1	CNTL CA2	CNTL CA3
APC1					DSC OL1 DSC OL2	DSC OR1						
MNA APC4				MDM OA1 MDM OA3	DSC OA1 DSC OA3							
MNA FPC1				PCMMU 1 PCMMU 2 MMU 1 OPS 1			PDI			PL RCDR		
MNA O14			DSC OF1 DSC OF4 DSC OM1 DSC OM2 MDM OF1 MDM OF2									
APC2								DSC OL1	DSC OR1 DSC OR2			
MNB APC5							MDM OA1 MDM OA2	DSC OA1 DSC OA2				
FLC2							PL SYS1 FM SYS 1					
MNB FPC2					MMU 2 OPS 1		PCMMU 2 OPS 2					
MNB R14		DSC OP1										
APC3											DSC OL2	DSC OR2
MNC APC6										DSC OA2 DSC OA3	MDM OA2 MDM OA3	
FLC3							PL SYS2 FM SYS 2					
MNC FPC3							PDI OPS 2			PCMMU1	PL RCDR	
MNC O16	MDM OF3 MDM OF4		DSC OF2 DSC OF3 DSC OM3									
MNC R14		DSC OP2										

**SINGLE BUS**

MNA FLC1 OR ESS1BC	MADS REVERSE RCD
MNA MPC1	MADS SIG COND, FDM, STR GAUGE
MNB FPC2	MADS RCDR PWR
MNB MPC2	MADS PCM
MNB A14	MASTER MADS
MNC MPC3	MASTER OEXPOWER WB, SG, PCM
CNTL CA3	MASTER OEX POWER CNTL
JSC-12829, SCP 1.9, REV F, PCN-13	

**Instrumentation Power (Watts)**

PSP	PDI	OIU	PI	OPS RCDR Replay/Rec/Stby
36.51	24.8	35	95.48	84 / 56 / 17

Figure 1.9-12. INST systems power buses

PCT TAPE	24 IPS		120 IPS		15 IPS		TLM bits 5 4 3 2 1
	Time to EOT	Time to BOT	Time to EOT	Time to BOT	Time to EOT	Time to BOT	
0	20:00	:00	4:00	:00	32:00	:00	0 0 0 0 0
3	19:25	:35	3:53	:07	31:04	:56	0 0 0 0 1
6	18:49	1:11	3:46	:14	30:07	1:53	0 0 0 1 0
10	18:13	1:47	3:39	:21	29:10	2:50	0 0 0 1 1
13	17:37	2:23	3:32	:28	28:12	3:48	0 0 1 0 0
16	17:01	2:59	3:25	:35	27:14	4:46	0 0 1 0 1
19	16:24	3:36	3:18	:42	26:15	5:45	0 0 1 1 0
23	15:47	4:13	3:11	:49	25:16	6:44	0 0 1 1 1
26	15:10	4:50	3:04	:56	24:16	7:44	0 1 0 0 0
29	14:32	5:28	2:56	1:04	23:15	8:45	0 1 0 0 1
32	13:54	6:06	2:48	1:12	22:14	9:46	0 1 0 1 0
35	13:15	6:45	2:40	1:20	21:13	10:47	0 1 0 1 1
39	12:36	7:24	2:32	1:28	20:11	11:49	0 1 1 0 0
42	11:57	8:03	2:24	1:36	19:08	12:52	0 1 1 0 1
45	11:18	8:42	2:16	1:44	18:05	13:55	0 1 1 1 0
48	10:38	9:22	2:08	1:52	17:01	14:59	0 1 1 1 1
52	9:58	10:02	2:00	2:00	15:57	16:03	1 0 0 0 0
55	9:17	10:43	1:52	2:08	14:52	17:08	1 0 0 0 1
58	8:36	11:24	1:44	2:16	13:47	18:13	1 0 0 1 0
61	7:55	12:05	1:36	2:24	12:41	19:19	1 0 0 1 1
65	7:14	12:46	1:28	2:32	11:34	20:36	1 0 1 0 0
68	6:32	13:28	1:20	2:40	10:27	21:33	1 0 1 0 1
71	5:50	14:10	1:12	2:48	9:20	22:40	1 0 1 1 0
74	5:07	14:53	1:03	2:57	8:12	23:48	1 0 1 1 1
77	4:24	15:36	:54	3:06	7:03	24:57	1 1 0 0 0
81	3:41	16:19	:45	3:15	5:54	26:06	1 1 0 0 1
84	2:57	17:03	:36	3:24	4:44	27:16	1 1 0 1 0
87	2:13	17:47	:27	3:33	3:34	28:26	1 1 0 1 1
90	1:29	18:31	:18	3:42	2:23	29:37	1 1 1 0 0
94	:45	19:15	:09	3:51	1:12	30:48	1 1 1 0 1
97	:00	20:00	:00	4:00	:00	32:00	1 1 1 1 0
100	ΔT for percent tape change 35-45 sec		ΔT for percent tape change 7-9 sec		ΔT for percent tape change 56-72 sec		1 1 1 1 1

JSC-12829, SCP 1.9, REV F, PCN-13

Figure 1.9-13. Percent tape vs. speed vs. time

## TITLE

CONSOLE DOCUMENTATION AND LOG KEEPING

## PURPOSE

To assure maintenance of adequate console records in order to permit reconstruction of test/mission events if required or to furnish after-the-fact information or reports. The SCP also lists the specific procedural and technical documents to be kept at each console.

## PROCEDURE

- A. Logs will be kept by the instrumentation and communications officer (INCO), communications support officers (RF COMM and DATA COMM), and instrumentation officer (INST) at all times. The logs will be recorded on mission log sheets. Following are examples of entries to be made:
  1. All significant console activities.
  2. Significant communications events not otherwise recorded.
  3. Problems or delays encountered in a test or mission phase.
  4. Communication malfunctions, possible causes, action taken, and action pending (MCC/STDN, orbiter, TV).
  5. Any time a mission rule is implemented.
  6. Space tracking and data network (STDN) status.
  7. During countdown operations, record Greenwich mean time (GMT) with occasional T-minus times for reference. During plus-time operations, record GMT with an occasional mission elapsed time (MET) recorded for reference.
- B. A summary of the log will be made in the handover sheet after each day's activity or shift.
- C. The following files will be maintained by INCO/COMM as applicable:
  1. Console logs
  2. Anomaly logs
  3. Handover sheets
  4. TV/OPS recorders (RCDRS) dump quality reports
  5. Spacecraft analysis (SPAN) chits
  6. Flight plan changes
  7. Miscellaneous (command history, flight notes, mission rule changes, etc.)
  8. Recorder management worksheet

- D. The duties of the individual assigned the task of updating a given set of documentation are as follows:
1. Verify that all materials indicated in part E. are available at the indicated console.
  2. Update documents with PCN's and DCN's in a timely fashion as these changes become available.
  3. Ensure that documents and/or binders that are no longer serviceable are replaced.
  4. Report to the FDF coordinator any discrepancies found during examinations of the documentation under their care.
- E. The following documents will be available in the locations shown in the following chart.

	FCR	MPSR
INCO/COMM Console Handbook (JSC-12829)	X	X
INCO Systems Briefs (JSC-18611)	X	X
Space Shuttle Systems Handbook (JSC-11174)	X	X
Flight Controller Operational Handbook (JSC-12805)	X	X
STS Flight Rules (NSTS-12820, Vol. A)	X	X
Flight Rule Annexes (NSTS-18308)	X	X
STS Flight Data File with FS sections	X	X
OI MDM/DSC Failure Impacts (JSC-16983)	X	X
Joint Operations Integration Plan (FS)	X	X
Operations Support Timeline (FS)	X	X
NOI binder	X	X
Flight Unique binder	X	X
Display and control boards	X	X
INCO LOG binder	X	
RF COMM LOG binder		X
DATA COMM LOG binder		X
INST LOG binder		X
INST Book (FS)		X
Chit and Anomaly binder		X
OEX Label Listing		X
Execute Package binder		X
Payload Mgmt Level C FSSR (JSC-19478) (FS) (available online)		X
Payload C & D Annex (JSC-14071) (FS) (available online)		X
SM Level C FSSR (JSC-19590) (FS) (available online)		X
PCMMU Bypass Bits (FS CD and hardcopies)		X
MAST MRL and downlist/downlink products		X
Command listing (FS)		X
Cargo Systems Manual (PL and FS)		X
IPCL		X
Space Shuttle Telemetered and Recorded Data Format Requirements (JSC-10784)		X

	FCR	MPSR
OMI S0007 (5 volumes) (available online)	X	X
OMI S0017 (available online)	X	X
OMI V1117 (available online)	X	X
Launch Commit Criteria	X	X
Telemetry and Command Characteristics Handbook (2 volumes) (JSC-08118)		X
NOSP (STDN 601)		X
TDRS NOSP (STDN 602)		X
NOSP Annexes		X
Flight Procedures Handbook		X
Flight SW Ops Notes and Waivers (JSC-19320)		X
Shuttle Operational Data Book		X
Calibration Handbook		X
Calibration Tables		X

## TITLE

PARAMETER DEFINITION AND RELATED SOURCE MATERIAL

## PURPOSE

To provide a listing of source documents which contain information relating to space shuttle parameters.

## GENERAL

The shuttle system is monitored through the use of digital parameter data. Various format types are used throughout the data management system. The source documents shown below contain information about the various parameter types.

In the past, differences between onboard and downlisted (D/L) data characteristics have led to confusion within the flight controller community. These differences can be explained by cross referencing the telemetry characteristic documents with the GPC data documents.

## RESOURCE DOCUMENTS

### Systems Management

Level C

Flight Software Requirements

Information available: This document contains information about GPC parameters and their associated data types. GPC data types and values may differ from their OI downlisted counterparts.

### Shuttle Calibration Data Book

Volume III

FOD Calibration Data

JSC-16486-(FLT NUM)

Information available: This document contains the coefficients used for the conversion of PCM counts to engineering units (calibration curves). Good source for computing the high and low values of a parameter from its PCM counts, (i.e., off-scale high and low). There is a separate book created for each shuttle flight.

### Telemetry Services Downlink Real time and Universal Data Display (UDD)

This workstation tool allows the user to view the data as uncalibrated or calibrated, view the calibration curves for parameters or change them. UDD also can be used for this purpose.

### PCMMU System Brief

Section 29

INCO System Briefs

Information available: This document contains the formats for PCMMU data transactions with the MDM's, the GPC's, and the downlisted NSP values.

### Master Measurement List

Available on the P51.KSC.NASA.GOV web site, this document contains all MSID's with channelization and format information.



#### Mission Information System Query

This workstation application allows the user to find parameter channelization and format information.

#### Flight Load CD ROM

This CD is kept at the DPS Support console and contains information about GPC processes, such as FDA, SM bypass, and parameter processing.

#### Payload Management Flight Software Requirements, JSC-19478 (FS)

Available online on SFOC Electronic Library System (SELS), this document contains the TFL/DFL and PSP configurations for each flight, as well as information on payload parameter processing in the SM and BFS.

#### Program Requirements Documents and Payload Interface Control Documents

Available on Payload Integration Library System (PILS), these documents describe requirements relative to payloads.

#### Flight Requirements Documents, NSTS 17462 (FS)

Available on PILS, these documents contain flight operations and equipment requirements.

#### Command and Data Annex 4, NSTS 21357 (FS)

Available on PILS, this document contains detailed payload data requirements.

**TITLE**

**COMMAND**

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

**PURPOSE**

To define a standard set of procedures to be used by the Instrumentation and Communications Officer (INCO), RF Communications (COMM), and Instrumentation (INST) personnel when command activity is required to reconfigure/control the communications equipment or as requested by other flight controllers.

These procedures detail the transmission of real-time commands, command loads, and equivalent DEU commands to the DPS system. Reference is made to enclosed diagrams, tables, Generic Command Server (GCS) workstation displays, and FCOH procedures.

**GENERAL**

The INCO/COMM/INST positions are responsible for uplinking all commands to the orbiter, with the exception of payload and abort commands. Table Maintenance Block Uplink (TMBU), DEU equivalent loads, delta NAV, state vector, landing site updates, quaternion reference, etc., are uplinked by INCO/COMM/INST, as requested by other positions and approved by the Flight Director (FD).

It is the responsibility of the command requester to ensure that his/her command loads are correct. The command requester shall provide INCO, COMM SUPPORT, or INST the following information before the command can be uplinked: Major Function (MF), DSM number, DEU number (if required), and verification of FD approval for uplink.

In general, two-stage uplink loads that are used primarily for maintenance and general operations do not require crew coordination. Two-stage loads that require specific conditioning for vehicle control or systems monitoring applications software are coordinated with the crew. There may be some specific exceptions for loads in this category because of their repetitive nature

**CAUTION**

Do NOT command during OPS transitions. Commanding during onboard software Operational Sequence (OPS) transitions can cause the GPCs to fail to sync. Take care to monitor the voice loops for OPS transition calls. Verify completion of all OPS transitions with the DPS officer before resumption of commanding.

**PROCEDURE**

The following steps demonstrate how to transmit a general command load. The steps assume that the Space Shuttle Program GCS has been initialized and that the command loads have been generated and loaded into GCS in accordance with applicable procedures found in each console operators Console Handbook.

The command load originator coordinates with the INCO on the INCO loop and provides the DSM number, the required uplink time, the MF, and any other pertinent data; i.e., DEU, DPS configuration. In addition, the requesting position should verify, via the Load Inventory display, that all desired loads are stored and unsafed.

NOTE

The originator of the load is the final authority on the correct DSM sequence to be uplinked.

Each originator notifies the FD of his uplink requirements on the FD loop. The FD assigns priorities and approves the command loads.

Normally, proper execution of an uplink command is verified by observing the Command Tracking display (Figure 3.1-1) or the S/W Command Panel display. If the uplink is a critical command or there is a problem with the uplink, the Uplink Verify display should be monitored (Figure 3.1-2).

START GMT	GMT	MF	DSM	TITLE	RSLT	CMP	INDEX	POSITION	NODE	SOURCE	PLD ID
036:15:14:32		SM	037	1881 - POCC CMD	TERU	VAL	19	PAYLOAD1	NPCC	NPCC	38
036:15:08:40		SM	036	1881 - POCC CMD	TERU	VAL	18	PAYLOAD1	NPCC	NPCC	38
036:14:56:25		SM	035	1881 - POCC CMD	TERU	VAL	17	PAYLOAD1	NPCC	NPCC	38
036:14:53:10		SM	034	1881 - POCC CMD	TERU	VAL	16	PAYLOAD1	NPCC	NPCC	38
036:14:49:43		SM	033	1881 - POCC CMD	TERU	VAL	15	PAYLOAD1	NPCC	NPCC	38
035:18:02:29		SM	021	1881 - POCC CMD	TERU	VAL	14	PAYLOAD1	NPCC	NPCC	38
035:17:53:21		SM	020	1881 - POCC CMD	TERU	VAL	13	PAYLOAD1	NPCC	NPCC	38
035:17:25:32		SM	019	1881 - POCC CMD	TERU	VAL	12	PAYLOAD1	NPCC	NPCC	38
035:16:50:31		SM	018	1881 - POCC CMD	TERU	VAL	11	PAYLOAD1	NPCC	NPCC	38
035:16:16:36		SM	017	1881 - POCC CMD	TERU	VAL	10	PAYLOAD1	NPCC	NPCC	38
035:16:15:18		SM	016	1881 - POCC CMD	TERU	VAL	9	PAYLOAD1	NPCC	NPCC	38
035:16:13:49		SM	015	1881 - POCC CMD	TERU	VAL	8	PAYLOAD1	NPCC	NPCC	38
035:16:11:58		SM	014	1881 - POCC CMD	TERU	VAL	7	PAYLOAD1	NPCC	NPCC	38
035:15:59:20		SM	013	1881 - POCC CMD	TERU	VAL	6	PAYLOAD1	NPCC	NPCC	38
035:15:52:13		SM	012	1881 - POCC CMD	TERU	VAL	5	PAYLOAD1	NPCC	NPCC	38

Figure 3.1-1. Command Tracking display

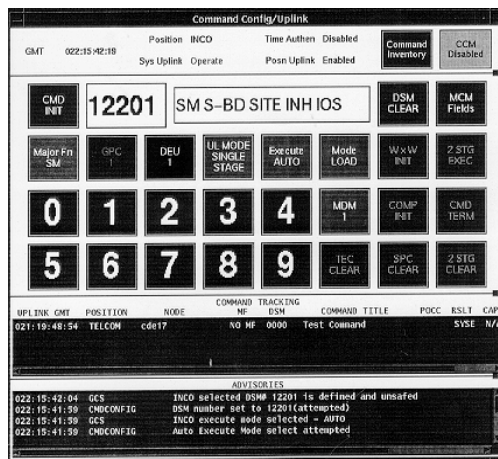
SM	DSM #	UP	DN	UP	DN	UP	DN	UP	DN		
01	0006	0000	15	0000	0000	29	0520	0000	43	0000	0000
02	0000	0000	16	0962	0000	30	4110	0000	44	0000	0000
03	0009	0000	17	0150	0000	31	0000	0000	45	0000	0000
04	0962	0000	18	4110	0000	32	0000	0000	46	0962	0000
05	0150	0000	19	0000	0000	33	0000	0000	47	0520	0000
06	4110	0000	20	0000	0000	34	0962	0000	48	4110	0000
07	0000	0000	21	0000	0000	35	0521	0000	49	0000	0000
08	0000	0000	22	0962	0000	36	4110	0000	50	0000	0000
09	0000	0000	23	0520	0000	37	0000	0000	51	0000	0000
10	0962	0000	24	4110	0000	38	0000	0000	52	0962	0000
11	0150	0000	25	0000	0000	39	0000	0000	53	0000	0000
12	4110	0000	26	0000	0000	40	0962	0000	54	4110	0000
13	0000	0000	27	0000	0000	41	0520	0000	55	0000	0000
14	0000	0000	28	0962	0000	42	4110	0000	56	0000	0000

Figure 3.1-2. Uplink Verify display

INCO/COMM/INST determines the current software and hardware configuration of the orbiter, and, if required, may consult with DPS on the MOCR DPS/CDMS loop.

The INCO/COMM/INST verifies that they are configured as follows:

- A. Verify that no command number (DSM) and title are displayed on the S/W Command Panel display (Figure 3.1-3) or that no command number is displayed on the DSM function of the hardware command panel. If there is a DSM number displayed, press the DSM CLEAR button on the panel. Both the hardware panel and the S/W Command Panel display will clear.



**Figure 3.1-3. Command Config/Uplink display**

- B. Select the LOAD or RTC mode of command by depressing LOAD MODE/RTC MODE button. This button toggles between the two states.
- C. For RTCs, select the two-stage or single-stage execution of command by depressing the TWO-STAGE/SINGLE-STAGE button. Loads are always automatically uplinked as two-stage commands.
- D. Select the auto execution mode of two-stage processing by depressing the AUTO EXECUTE/MANUAL EXECUTE button. (This button has no effect on single-stage RTCs.)
- E. Select the destination of a command load by using the MF or GPC ID buttons. The MF button toggles through SM, PL, GNC, and BFS. The GPC ID buttons toggle through GPC1, GPC2, GPC3, GPC4, GPC5, and GPC ALL. If the command to uplink is an RTC, the destination MDM must be selected with the MDM 1/2 button.
- F. Only one MF or GPC ID selection is possible for a given load, and only MDM 1 or 2 can be selected.
- G. If DEU equivalentents are to be transmitted, DPS must tell INCO which DEU is being emulated. INCO selects the DEU by depressing the DEU ID button. It toggles through the four valid DEU numbers.
- H Enable the panel by depressing the ENABLE/DISABLE button. The CCM Enable button changes from red to green.

The CAPCOM must inform the crew about any GNC, DEU equivalent, or TMBU loads. For DEU loads when the crew is awake, the crew informs the MCC which DEU is being configured for the uplink.

**Select the command load number (5 digits) or RTC number (4 digits) by using the digit buttons on the panel. The DSM number will be displayed along with the command title (S/W Command Panel display only) when a valid DSM number is entered.**

NOTE

If the DSM "dialed in" is safed, the DSM number and title are displayed in red characters on the S/W Command Panel display. On the hardware panel, the DSM CLEAR button blinks. If the DSM dialed in does not exist in the command server, the DSM number is displayed with red characters, and no title is displayed. On the hardware panel, the DSM CLEAR button blinks.

Variance from this configuration indicates a problem that should be resolved with COMMAND on the COMMAND loop.

The INCO/COMM/INST can now send the command load or RTC by depressing the CMD INIT button. This action causes the GCS to perform validity and configuration checks. The command is transmitted from GCS to the uplink Front End Processor (FEP) for shipment to the orbiter if the configuration checks are passed. The uplink verification display is monitored to verify a good two-stage comparison on the uplinked command. The DN column is filled via downlist data from the orbiter. When the data in the DN column are complete, a comparison is made of the DN/UP columns. When the Up and Down columns command data words agree, the TWO STAGE EXEC button is highlighted on the S/W Command Panel display (mismatches are discussed later in this procedure). The TWO-STAGE BUFFER EXECUTE (DSM 4060) is sent automatically if **auto execute** was selected.

If more commands must be uplinked, depress the DSM CLEAR button to clear the DSM number and title on the S/W Command Panel display and repeat the above procedure. If there is a mismatch, it is probably caused by data dropout in the uplink or downlink. If time permits, depress the COMPARE INITIATE button. If the mismatch is sustained, depress the TWO-STAGE BUFFER CLEAR button and observe the data in the DN column of the uplink verification display. Reinitiate the sequence by transmitting the load or two-stage RTC.

An alternate method is to depress the W-x-W INITIATE button on the S/W Command Panel display (the GCS automatically does a bit-by-bit comparison of the command load and downlist data). The Word-by-Word (WxW) compare begins with the first bit mismatch. If the first mismatch is early in a long command bit sequence, the WxW routine could be relatively long. The WxW INITIATE capability does not exist for the BFS MF. An attempt to execute a WxW compare while the BFS is selected causes an error message on the S/W Command Panel display.

If two or more command loads are chained and auto execution is selected, the GCS automatically compares and TWO-STAGE BUFFER executes each sequential load. If there is a noncompare, the GCS automatically stops the transmission. In this case, the INCO/COMM/INST should execute a two-stage buffer clear and reuplink the entire sequence.

The INCO/COMM/INST should disable his/her interface to GCS by depressing the CCM ENABLE/DISABLE button when uplink of commands is not required for a few minutes or when leaving the console. During ascent phase, the MPSR command panels should remain disabled until post-MECO, unless explicitly requested to perform commanding by the INCO.

There are some specific command uplink requirements.

- A. Delta NAV state vectors may be uplinked to the GNC MF.

NOTE

Details necessary for delta NAV state generation are provided in the GPO (pronounced Gee Po or Guidance) Console Handbook.

Care must be taken not to uplink delta NAV state loads near or during an OPS transition.

CAUTION

Never send the same delta NAV state twice because the delta will be added to the state vector each time it is sent.

- B. Launch targets may be uplinked to the GNC or BFS MFs.

NOTE

Details necessary for launch target generation are provided in the FDO Console Handbook.

Targets are not transmitted until the crew has acknowledged receipt of the Preliminary Advisory Data (PAD).

- C. TMBU may be uplinked to the SM or BFS MFs.

NOTE

Details necessary for TMBU generation are provided in the INCO Console Handbook.

Ensure that the crew does not have SM SPEC 60 because it will inhibit the load from executing onboard. Further details regarding transmission of TMBUs can be found in the appropriate section of the INCO/COMM Console Handbook.

- D. Telemetry Format Load (TFL) and DECOM Format Load (DFL) may be uplinked to the SM MF or while the GNC MF is in OPS 9.

NOTE

Details necessary for TFL/DFL load generation are provided in SCP 3.9 (COMMAND SYSTEM: TFL/DFL OP CODE UPLINK COMMAND PROCESSING) in the INCO/COMM Console Handbook. This applies to building SM TFL loads; there are no plans or procedure for building G9 TFL loads.

Ensure that the crew does not use SM SPEC 62 because it will inhibit the load from executing onboard.

- E. DEU equivalent loads may be uplinked to the GNC or SM MFs.

DPS coordinates with the crew to ensure which DEU is to be used for DEU uplink and to ensure that the DEU MF switch matches the MF selected by INCO.

If the sequence is to tie up the specified DEU for a "significant" period of time, uplink UPLINK ACTIVITY ON, DSM 4064.

When the DEU equivalent commanding is complete, uplink UPLINK ACTIVITY OFF, DSM 4065.

Guidelines and Constraints

1. Although it is possible to uplink to a CRT that is powered off, DPS prefers to uplink DEU equivalents to a CRT that is powered on.
2. DEU equivalent uplinks that require calling a specific SPEC are coordinated with the crew because onboard SM SPEC call capability is affected.
3. All DEUs sent while the crew is awake should be coordinated with the crew.

- 4. The ground is prohibited from uplinking DEU equivalents that would cause OPS/major mode changes, except for MPS safing commanding that requires the G9 major mode.
  - 5. DEU equivalents are not available in the BFS.
- F. Stored Program Commands (SPCs) may be uplinked to the SM or BFS MFs.

SPCs are generated by the INCO/COMM/INST and are used to control and configure comm system equipment onboard the orbiter. See SCP 3.15, Stored Program Command (SPC): Build and Transmission Procedures in the INCO Console Handbook for details.

**Load Safing** (ref: FCOH/SOP 3.20)

A. Individual Safing

Permission, certain commands are identified as individually safed commands; i.e., inhibited from being uplinked. Such commands are initialized in the "safed" state at GCS initialization. Commands that are not safed are considered enabled for uplink.

Procedure

If a safed command is required to be uplinked, the appropriate flight controller requests that COMMAND unsafe the command for uplink by providing the DSM number. When uplink is completed, the flight controller requests that COMMAND resafe the DSM number. If a command (RTC, SPC, or load) that was not identified as an individual safed command is to be safed, the flight controller provides COMMAND with the DSM number of the command to be safed. The Command Inventory display (Figure 3.1-4) is used to verify that a command is safed or unsafe.

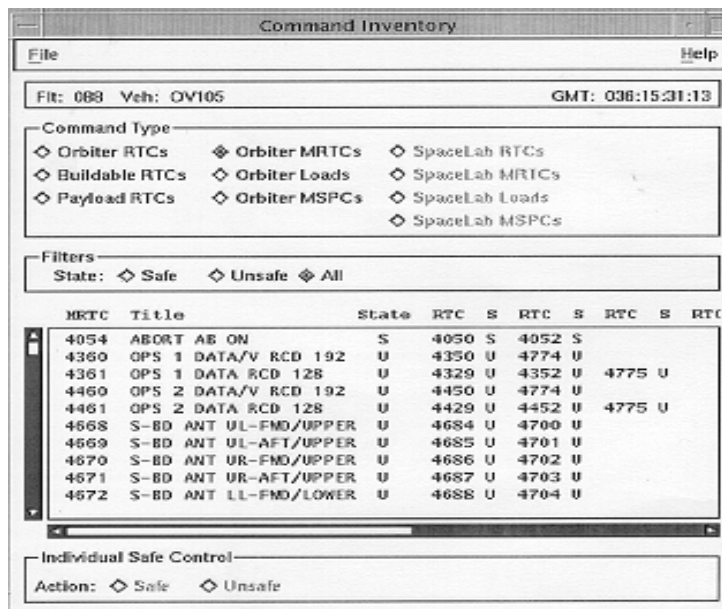


Figure 3.1-4. Command Inventory display

B. Group Safing

Permission, some commands are assigned to safed groups, referred to by their group identification number (1-29 for orbiter RTCs and SL1-SL30 for Spacelab RTCs). There is a maximum of 10 commands per group. Such command groups are initialized in the safed state at GCS initialization. When these command groups are not safed, they are said to be enabled for uplink.

Procedure

Safed command groups are disabled/enabled by the COMMAND Controller from the safed groups display (Figure 3.1-5). If a member of a safed command group is required to be uplinked, the appropriate flight controller contacts Command to have the safed command group enabled. If an individual command within a safed command group is safed individually in addition to being group safed, these commands must also be singularly unsafe.

The command group(s) are re-safed (disabled) once there is no longer a need to uplink the commands. The flight controller requests COMMAND to disable the command group by providing the group number.

If a command (RTC, SPC, or load) that has not been previously identified as a safed command is to be added to a safed command group, the flight control position responsible provides COMMAND with the DSM number to be safed and the safed group number.

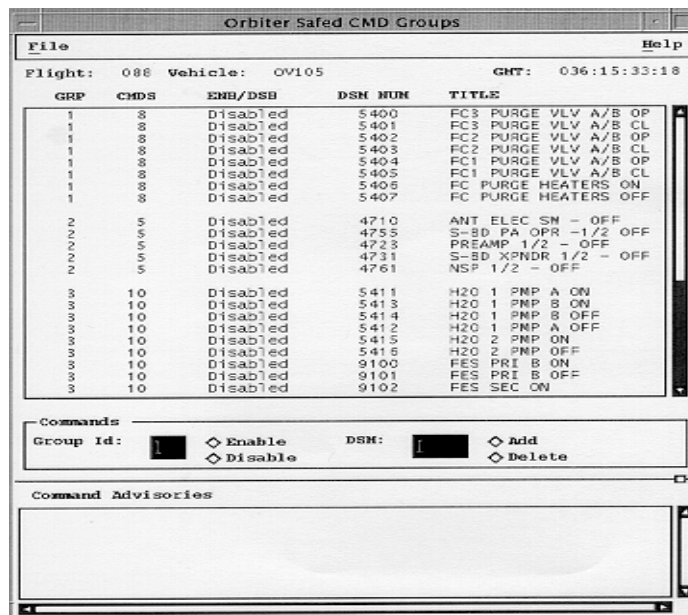


Figure 3.1-5. Orbiter Safed CMD Groups display

Command Counter

The command word counter was added to the MCC command system for comparison with the onboard command word counter. If these counters are diverging from each other, some facility, other than the MCC, is attempting to command to the orbiter. In this case, the crew should take the panel C3 Uplink switch to NSP BLOCK to prevent the unauthorized commands from being processed. Once the problem has been resolved, the crew should move the panel C3 Uplink switch back to ENABLE.



**TITLE**

INCO OMI/PRELAUNCH PROCEDURES

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

-----  
**COMMAND RESTRICTIONS/CONSTRAINTS**

1. Hazard/safety implication (should/are safed): LO<sub>2</sub> prevalue and overboard bleed valve commands that may be sent as a part of OMI S0007V5 Sequence 131 are safed. Catastrophic failure can occur if sent at incorrect time.
2. Valid software major modes (if applicable, include OPS Mode X01, X02...):

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC		X								
SM										
BFS		X								
PL										
OPS 0										

3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: Some commands must be sent quickly to avoid excessive loss of telemetry. Crew coordination is required for NSP switches. (Fault MSG to CREW).

-----  
**Figure 3.2-1. Command restrictions/constraints**

**PROCEDURE**

This procedure will review the general activities the INCO and COMM/INST MPSR must accomplish in the prelaunch or post scrub timeframe. Nominal as well as off nominal activities will be outlined. It should be remembered that this procedure *summarizes* the KSC operation and maintenance instructions (OMI's) and Launch Commit Criteria (LCC) documents. These are the controlling documents and as such should be carefully reviewed by the team during sims and prelaunch. Marking and tabbing the OMI's and LCC are especially helpful.

Note: The prelaunch OMI procedures are guided by the Network Test Director (NTD) at KSC. All LCC violations and OMI deviations are reported to NTD. MCC-H-generated OMI deviations and

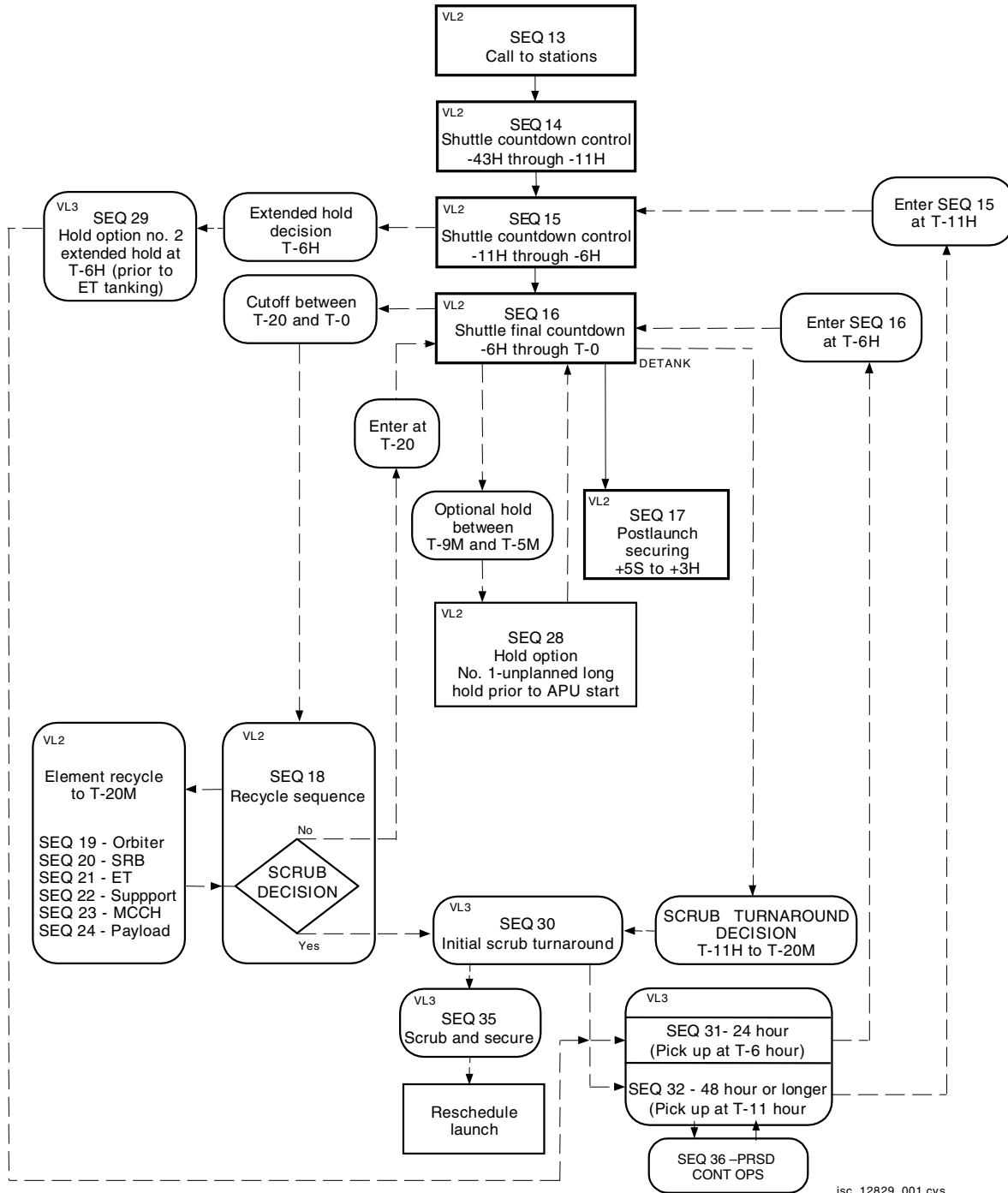
detected LCC violations are reported to the NTD by the Flight Director (FD). The KSC Comm counterparts are referred to as CCSE, and the INST counterparts are referred to as CISL. There are also two KSC engineering team lead counterparts referred to as ETLs. All comm with the Astronaut Support Personnel (ASP) in the cabin will be conducted on ICOM A. The following voice loops should be monitored for all prelaunch operations through liftoff : OIS 232 - NTD, OIS 155 - ORB COMM (CCSE), OIS 145 - ORB INST (CISL), OIS 252 (NAV AIDS), OIS 173 (INST SYS B/U), OIS 214 - ICOM A.

Also, all prelaunch commands are normally sent by the INCO.

A. OMI S0007 - SHUTTLE LAUNCH COUNTDOWN

All prelaunch and launch scrub operations are called out in OMI's, which are managed by KSC.

Figure 3.2-2 shows the launch countdown flow through S0007 and is included as a reference only. This figure is included in the front of S0007VL2.



isc 12829 001.cvs

Figure 3.2-2. Launch Countdown Flow

Volume 1

This volume is used by KSC only.

Volume 2

This is the PRIME control document for countdown. It references specific procedures in other volumes and other documents such as the V1117. MCC typically begins support during sequence 14 at T - 11 H and holding. This volume also includes the initial steps for scrubs/recycles back to T - 20 M and for optional holds after T - 9 M.

Volume 3

This volume contains the scrub procedures.

Volume 4

This volume contains specific systems procedures. The following sequences are of interest to INCO :

SEQ 38 - INSTRUMENTATION

All recorder (MADS/OEX/OPS/PLR/SSR) configuration and activation procedures and the PCM to GSE Control procedure.

SEQ 49 - DPS SYSTEMS

TFL/DFL Load procedures.

SEQ 76 - SHUTTLE ASCENT SWITCHLIST

Ascent switchlist procedure.

Volume 5

This volume contains all the preplanned contingency procedures that are often referenced in the LCC. It also contains the emergency vehicle safing procedures in the *yellow* pages. The following sequences are of interest to INCO :

SEQ 112 - COMM AND TRACK

SEQ 113 - INST LCC WORKAROUNDS

SEQ 117 - G9/G1 LAUNCH POLYNOMIAL UPDATE [Ref FCOH (CPH) 3.2.6]

SEQ 132 - EMERGENCY INSTRUCTIONS - LOSS OF FIRING ROOM CONTROL/VISIBILITY, OPTION C - T - 31 SECONDS THRU SSME START

This is the procedure that involves INCO to safe the vehicle via command. The rationale and MCC procedure are described in FCOH 3.1.6, MPS SAFING COMMAND PROCEDURES FOR LOSS OF LPS/LDB CAPABILITY (and the Command Procedures Handbook). **READ THIS BOOSTER PROCEDURE IN THE FCOH (CPH)!**

B. SHUTTLE COUNTDOWN TIMELINE

The following is a timeline of INCO related activities during the prelaunch countdown. The activities that require INCO participation are in **boldface**.

Enter SOOO7 VL2 SEQ 13 at T - 43H00M and holding.

T - 43H00M KSC call to stations.

Enter SOOO7 VL2 SEQ 14 at T - 43H00M and holding.

T - 40H35M DFL load for flight (VL4 SEQ 49).  
OMRS S00FAO.301-IR

T - 40H25M TFL load for flight (VL4 SEQ 49).  
OMRS S00FAO.301-IR

T - 39H55M Downlink format change (if launching in soft TFL).

T - 33H30m MADS FDM/PCM test (OV103,104,105) (VL4 SEQ 38).

T - 32H30M MADS PCM/RCDR sample test (OV103, 104, 105) (VL4 SEQ 38).

T - 40H00M Transport COMSEC unit to orbiter.

T - 39H00M COMSEC 1 and 2 key loading (OMI S9001 VL2).

T - 29H00M OI PCM to GSE control (VL4 SEQ 38).

T - 18H00M OEX/MADS/FDM/PCM test (OV102) (VL4 SEQ 38).

T - 17H30M MADS RCDR configure for LCD (OV103, 104, 105) (VL4 SEQ 38).  
manual calcs and PNL C3/A7L switch configurations.  
OEX/MADS RCDR configure for LCD (OV102) (VL4 SEQ 38).  
MADS FDM track assignments and manual calcs.  
PNL C3/A7 switch configurations.

OI RCDR configure for LCD.  
erases and positions SSR's or OPS 1/2 and PLR.  
configures PNL A1R switches.

**T - 11H00M L - 1 day briefing.**  
Downlink format change (if soft TFL required for launch and not already active)  
Ascent switchlist (VL4 SEQ 76).

**T - 11H00M COMM Activation MCCH (V1117 Task 8). (See section D of this SCP.)**

Enter SOOO7 VL2 SEQ 15 during T - 11H00M hold.

**T - 09H00M COMM CMD to Launch MCCH (V1117 Task 8). (See section D of this SCP.)**

T - 07H00M CCSE verifies S-band config.  
MCCH Abort Advisory checks (FD/FDO).

Enter SOOO7 VL2 SEQ 16 during T - 06H00M hold.

- T - 06H00M Go for ET tanking.
- T - 04H30M **MILA Antenna align.  
command freq HI (LO).  
freq LO must be UNSAFED!  
Uplink PASS preflight RCQ QTY correction (RCS PVT init).**
- T - 04H00M MILA switch to secondary antenna.
- T - 03H30M **XPNDR switch to launch freq  
command freq LO (HI).  
freq LO must be UNSAFED!**
- T - 03H00M (hold) Flightcrew Wakeup.  
MCC Comm check with ASP (SIMO A/G A/A Delay Adjustment).  
Flightcrew weather briefing.  
Pre-Ingress switch reconfig (OI PCMMU PWR - 1).  
OARE activation/**SSR 1 or PLR to record OARE data.**  
**Uplink variable ascent parameters if required.**
- T - 03H00M (hold) Remove GSE control from PCM.
- T - 02H45M LCC status report.
- T - 02H25M Flightcrew ingress.  
Comm check with MCC.
- T - 01H35M A/G Voice checks (CDR and PLT - A/G 1, A/G 2, A/A, SIMO. remainder of crew - SIMO ONLY).
- T - 01H25M ASP leaves crew module (PS ATU).
- T - 01H20M **Uplink Launch Polynomials/Targets, if required. [FCOH 3.2.6 (CPH)]  
GPC D/L dump.**
- T - 00H55M **S-band System to HI PWR/FM Activation.  
Command PWR AMP STBY 2 –ON.  
Command PWR AMP STBY 1 –ON.  
command PREAMP 2 - ON.  
command PWR AMP 2 - ON.  
command FM System 1 -ON (√SSME input).  
command S-band Mode - STDN HI.  
MILA to JSC data checks.**
- T - 00H25M SIMO A/G voice checks.
- T - 0H20M (hold) **Uplink remaining ascent variable parameters (if required).**  
If P/L comm system ON, command to OFF (must be performed in G9).
- T - 0H20M PASS OPS 1 transition.
- T - 00H18M30S BFS OPS 1 transition.  
T-20M GPC dump (approx. 10 minutes to complete).
- BFS WILL TAKE CONTROL OF THE PL BUSES - CMD VIA THE BFS MF !**
- T - 00H16M **Uplink BFS loads (as required).**

**TMBU's/TDRS state vector/Launch target loads.**

**NOTE:**

Only 1 TDRS SV can be uplinked to the BFS for use at any one time until OI-30. For OI-29, only uplink a SV2 - 47 command prelaunch. For OI-30 and subs uplink all three new TDRS SVs (SV1 -171, SV2 -47, SV3 -275)

- T - 00H12M            Activate OEX Recorder (OV102) (VL4 Seq 38).**
- T - 00H09M (hold)    Uplink IMU Misalignment Correction (if required).  
                                 Ref FCOH 3.2.7 (CPH)  
                                 Uplink PASS target load (if required).  
                                 Uplink G1 Launch Polynomial (if required) (VL5 Seq 117).  
                                 Uplink BFS G1 Launch Targets (if required for RNDZ).  
                                 Activate Recorders (SSR's or OPS 1/2, PLR, MADS) (VL4 Seq 38 L-  
                                 0H15M00S).**
- T - 00H08M            Uplink Ascent SPC (DSM 12101).**
- T - 00H05M25S        The ground launch sequencer (GLS) takes a snapshot of OPS 2 BITE,  
                                 OPS 2 TEMP, and OPS 2 MOTION TLM at approximately T - 5 min 25  
                                 sec. If any of these parameters are out of limits, the GLS will  
                                 automatically hold at T - 5 min ASAP, the INCO must reconfigure OPS 1  
                                 to record both ME and OI by commanding OPS 1 STOP, OPS 1 RCD  
                                 PARALLEL A, and inform KSC that we are go for launch with only one  
                                 recorder (LCC). The GLS will not hold for an OPS 1 problem. If OPS 1  
                                 fails, take no action but inform KSC that we are go for launch with only  
                                 one recorder (LCC).**
- The GLS continuously monitors SSR 1 & 2 Critical BITEs and will hold if  
                                 both show failed down to T-5M. If only one SSR fails, then no SSR  
                                 reconfiguration is required since both record OI simultaneously.**
- T - 00H00M31S        GLS GO for Auto Seq Start.**
- T - 00H00M10S        GLS GO for SSME Start.**
- T - 00H00M06S        SSME Start.**
- T - 00H00M00S        SRB Ignition  
                                 MILA deselect KSC uplink on A/G 1/2 and A/A.**

**C. LAUNCH COUNTDOWN CONTINGENCY PROCEDURES**

S0007 VL2 Seq 18 - Recycle Sequence

In the event of a launch scrub or recycle inside T - 20, this sequence in volume 2 will be run.

**ASAP after entering this sequence:**

- INCO - Clear SPC in BFS.**
- INCO/COMM - Verify BFS buffer count to zero.**

During this sequence, KSC will take the PCMMU to remote, and the OPS 1 to OPS 9 transition will take place. The GNC will obtain control of the PL Buses, and subsequent commanding will be via the **GNC MF**.

If this sequence is entered inside T - 9 (recorders already activated), then you will be directed to sequence 23 (see below), the MCCH recycle. Upon completion of your steps in seq 23, you will return to sequence 18 and either proceed from T - 20 for another launch attempt (in seq 16) or go to sequence 30 for scrub turnaround.

#### S0007 VL2 Seq 23 - MCCH Recycle

INCO steps here are stopping the SSR's or OPS and payload recorders and powering off MADS (or stopping OEX if OV102). SSR 1 or OPS 2 will be played back here if a scrub has been declared.

There are *optional* steps to erase SSR's or OPS 1 and PLR and rewind (via PB) OPS 2. Perform these steps **ONLY** if absolutely necessary (see note below). Consult CISL of your decision. Also, if a scrub is declared, MCC will perform a playback of SSR 1 or OPS 2 via command to recover the ICOM loops (KSC does not record these loops). This will occur *after* the last crewman has egressed the vehicle.

After completing this sequence, you will return to sequence 18.

Note: Space shuttle main engine (SSME) data requires 8 minutes prelaunch plus 18 minutes post-launch plus any possible holds. Allow 30 minutes of record time to be safe (64 minutes available). Thus, if OPS 1% tape > 50, then perform erase steps (SSR 2 does not provide status on memory used by SSME data). ET/SRB data is required to be recorded on Seq 1 only of the MADS recorder. Allow 30 minutes of record time to be safe (120 minutes available). Thus, if MADS % tape > 75 then reconfiguration will be required.

#### S0007 VL3 Seq 30 - Scrub Turnaround

This sequence does initial scrub/turnaround work. There are **NO** INCO actions. CCSE at KSC will command the orbiter to STDN LO and turn the FM OFF. Shortly thereafter, JSC is released from support.

From sequence 30, the recycle will proceed to sequence 31 for a 24-hour turnaround, sequence 32 for a 48-hour or longer turnaround, or to sequence 35 to secure and reschedule a new launch date.

#### S0007 VL3 Seq 31 - 24-Hour Turnaround

There are **NO** INCO actions. Note that the comm systems remain powered.

This sequence will return to sequence 16 at T - 6 H.

#### S0007 VL3 Seq 32 - 48-Hour or Longer Turnaround

There are **NO** INCO actions. Note that CCSE will command the entire comm system OFF. INCO will command the comm system back on at T - 16 H (V1117 Task 11 - Comm System Configure to T-11H, "short Comm Act").

This sequence will return to sequence 15 at T - 11 H.

#### S0007 VL5 Seq 136 - Loss of Firing Room Control/Visibility



This sequence is found in the yellow EMERGENCY pages at the end of S0007VL5. The only INCO actions required are for the Option C scenario (hold or abort between -T - 31 sec and SSME start *combined* with the loss of firing room control/visibility).

This is the procedure that involves INCO to safe the vehicle via command. The rationale and MCC procedure are described in the FCOH section 3, MPS SAFING COMMAND PROCEDURES FOR LOSS OF LPS/LDB CAPABILITY (and the Command Procedures Handbook).

**READ THIS BOOSTER PROCEDURE IN THE FCOH OR CPH!**

D. V1117 - COMM ACTIVATION/COMMAND TO LAUNCH CONFIG

This book provides procedures for Communications checkout on the PAD in support of orbiter integrated testing. The two tasks of interest to INCO are Task 8 - Comm Activation/Command to Launch MCCH Option, and Task 11 - Comm System Configure to T - 11 Hours.

Task 8 - Comm Activation (T - 11H, L - 23H)

The purpose of this procedure is to configure and checkout the Comm system at the PAD, using MCCH for launch. The following systems are checked in this procedure:

- Audio System
- GCIL DCDR's
- STDN HI - HDR/sys 1
- STDN LO - HDR/sys 1
- FM 1/2 (SSME Mode)

All checks are done in launch freq.

This procedure requires INCO, GC, and FD support from the MCC. The following is a detailed timeline of events during Comm Activation. The GNC has control of the PL Buses so all commanding will be done via the **GNC MF**.

KSC activates S-band PM system 1/FM system 1/UHF.

- Verify initial configuration
  - S-band PM System 1
  - STDN HI
  - FREQ = Launch freq
  - HDR UP/DN
  - Coding ON UP/OFF DN
  - Encryption RCV
  - FM 1 ON (SSME Mode)

MCC verifies acceptable D/L data from MILA.

MILA acquires the orbiter.

MCC verifies acceptable D/L data from MILA.

MCC (Comm Tech) performs extensive audio checks.

Command the GCIL DCDR's ON (DSM 4370, 4372).

Command REVERT to PANEL RESET (DSM 4376) via DCDR A.

Command STDN LO MODE (DSM 4735).

MCC verifies acceptable D/L data from MILA.

Command PWR AMP OPR 1/2 OFF (DSM 4755).  
***this command must be UNSAFED!***

Command PA STBY OFF (DSM 4751) via DCDR B.

Command FM SYSTEM 2 ON (DSM 4782).

Command FM SYSTEM 1/2 OFF (DSM 4781).

*Command XPNDR RCV ONLY (DSM 4743), if required.*

Comm Activation is complete! Verify final config

- S-band PM System 1
- STDN LO
- FREQ = Launch freq
- HDR UP/DN
- Coding ON UP/OFF DN
- Encryption RCV
- FM OFF

*Remember to resafe the commands that were unsafed during this procedure.*

Task 8 - Comm Command to Launch Config - MCCH Option (T - 9H, L - 13H)

This procedure is a continuation of the Comm activation procedure. The following systems are checked in this procedure:

- STDN LO - HDR/sys 1
- STDN HI - HDR/sys 1
- TDRS - HDR/Coding ON/sys 1 and 2
- STDN HI - HDR/Coding OFF/sys 2
- STDN HI - HDR/Coding ON UP-OFF DN/sys 2
- XPNDR 1/2 Threshold checks
- STDN LO - HDR/Coding ON UP-OFF DN/sys 2

All checks are done in launch freq

The following is a detailed timeline of events during Comm Command to Launch. The GNC has control of the PL Busses so all commanding will be done via the **GNC MF**. Initial configuration is same as final config of Comm Activation above.

***Start the command sequence via DCDR A.***

Command PA 1 ON (DSM 4754).

Command PA 2 STBY ON (DSM 4752).

*Command XPNDR T/R (DSM 4742), if required.*

Command PI SWEEP WIDE (DSM 4821).

Command STDN HI MODE (DSM 4734).

MCC verifies processing 192 kbs data plus voice.

Command TDRS MRTC (DSM 1505) via **TWO-STAGE MANUAL EXECUTE MODE!**

This MRTC is stored in the MEDS directory and contains the following commands:

DSM 4733 TDRS Mode.  
DSM 4738 SPRD ON.  
DSM 4759 U/L HDR.  
DSM 4764 D/L HDR.  
DSM 4766 XPNDR FLTR WIDE.  
DSM 4772 D/L Coding ON.  
DSM 4770 U/L Coding ON.

Command TWO-STAGE BUFFER EXECUTE (DSM 4060).

**The remaining commands will be via DCDR 2.**

Command PWR AMP 2 ON (DSM 4756).

Command PRE AMP 2 ON (DSM 4724).

Command ELEC 2 (DSM 4711).

Command NSP 2 ON (DSM 4762).

Command XPNDR 2 (DSM 4732).

MCC verifies processing 192 kbs data plus voice.

Command STDN HI SALVO (DSM 4472).

*NOTE: Uplink coding goes OFF!*

MCC verifies lock on D/L data.

Command U/L CODING ON (DSM 4770).

Command XPNDR 1 ON (DSM 4730) for Threshold check.

Command XPNDR 2 ON (DSM 4732) for Threshold check.

Command STDN LO MODE (DSM 4735).

Command PA 1/2 OPR OFF (DSM 4755).

**this command must be UNSAFED!**

Command PA STBY OFF (DSM 4751).

Command PRE AMP 1/2 OFF (DSM 4723).

**this command must be UNSAFED!**

Comm Command to Launch is complete! Verify final config

S-band PM System 2  
STDN LO  
FREQ = Launch Freq  
HDR UP/DN  
Coding ON UP/OFF DN  
Encryption RCV  
FM OFF

*Remember to resafe the commands that were unsafed during this procedure.*

Task 11 - Comm System Configure to T - 11 Hours

This procedure is to be used for a Comm Activation and Configure to T - 11H from a scrub/recycle (48 or 72 hours).

The following is a detailed timeline of events during Comm System Configure to T - 11H. The GNC has control of the PL Buses so all commanding will be done via the **GNC MF**. Note that the Comm system was powered down in command mode during scrub/recycle. The GCIL is still powered ON and in CMD mode.

KSC activates S-band PM System 1/FM System 1/UHF.

Verify initial config  
S-band PM System 1  
STDN HI  
FREQ HI  
HDR UP/DN  
Coding OFF UP/DN  
Encryption RCV  
FM System 1 ON (SSME Mode)

MCC verify acceptable D/L data (hardline) from MILA.

MILA acquire orbiter.

MCC verify acceptable D/L data (RF) from MILA.

Command PREAMP 2 ON (DSM 4724).

Command PWRAMP 2 ON (DSM 4756).

Command ELEC 2 ON (DSM 4711).

Command XPNDR 2 ON (DSM 4732).

Command NSP 2 ON (DSM 4762).

MCC verify acceptable D/L data (RF) from MILA.

Command STDN LO MODE (DSM 4735).

MCC (Comm Tech) performs audio checks.

Command ELEC 1 ON (DSM 4709).

Command XPNDR 1 ON (DSM 4730).

Command NSP 1 ON (DSM 4760).

Command PWRAMP 1/2 OPR OFF (DSM 4755).

***this command must be UNSAFED!***

Command PREAMP 1/2 OFF (DSM 4723).

***this command must be UNSAFED!***

Command PWRAMP STBY OFF (DSM 4751).

Command FREQ LO (DSM 4740) if required for launch.  
***freq LO must be UNSAFED!***

Command FM System 1/2 OFF (DSM 4781).

Comm system configuration to T - 11H is complete! Verify final config  
S-band PM System 1.  
STDN LO.  
FREQ = Launch freq  
HDR UP/DN.  
Coding OFF UP/DN.  
Encryption RCV.  
FM OFF.

*Remember to resafe the commands that were unsafed during this procedure.*

#### E. NETWORK/MCC PRELAUNCH EVENT TIMELINE

The Launch Count is the document that contains the countdown preparations for the MCC, NASCOM, GSTDN, and TDRS networks. It is issued as a DCN to the NOSP for each mission and is distributed to the INCO and INST consoles several days prior to launch. The following is a timeline of events of particular interest to INCO and is for **REFERENCE ONLY**.

L - 33H00M	JSC/GSFC/NGT/MSFC/CSTC IP Network Validation Test.
L - 31H45M	JSC/MILA/JDI Data flow test.
L - 30H00M	Configure all voice loops to KSC. JSC FEPS allocated and GCS checked out.
L - 26H00M	MILA/JSC Interface validations. MILA flow hardline telemetry to MCC. Activate B30 access control.
L - 24H00M	L - 1 day briefing. FDF Transmit Launch and contingency support vectors to WSGT - AOA,RTLS,TAL,BAL,ECAL,Launch. FDF Transmits TDRS State Vectors to JSC. CAS data enabled to GSFC and WSC. Remote POCC command/telemetry interface checks performed.
<b>L - 23H00M</b>	<b>Comm Activation Support.</b>
L - 20H00M	SSME and SSR/OPS Recorder data flow test.
L - 14H00M	JSC/WSC OCA loopback test..
<b>L - 12H20M</b>	<b>Command to Launch Config support.</b>
L - 10H35M	Abort Advisory checks support.
L - 10H00M	WSC to JSC IONET interface check using WSC <i>data generator</i> .
L - 08H00M	Command server selectovers performed.

<b>L - 06H50M</b>	<b>MILA Antenna align.</b>
<b>L - 04H30M</b>	<b>CMD safe alternate frequency command.</b>
L - 04H20M	A/G voice checks and echo adjustments.
L - 03H00M	Receive updated TDRS state vectors if required.
L - 02H15M	Transmit Nominal Post-MECO and OMS2 vectors to GSFC.
L - 01H45M	GC Performs prelaunch briefing to GSFC and ground stations. S-band to high power/FM activation support.
L - 01H30M	Verify MILA best source select circuitry (MILA prime, MILA backup, PDL, JDI, and SLSS).
L - 00H45M	SIMO voice check support (ECHO adjustment, if required). Disable MER/SCA display request capability and verify that all MED's not required are logged off.
L - 00H30M	TDRS support begins - CMD verifies GCMR/valid ODM's.
L - 00H22M	All ground stations GO/NO GO for launch.
<b>L - 00H05M</b>	<b>Verify all unnecessary command consoles are DISABLED.</b>

#### F. LCC MONITORING AND VIOLATION REPORTING

LCC monitoring for the prelaunch phase occurs from T - XX hours until T - 31 seconds. LCC monitoring will also occur for MCC-H supported tests. This normally is in support of Terminal Countdown Demonstration Tests. The INCO and COMM/INST MPSR will participate in two types of LCC monitoring and reporting. The first type is that which INCO is directly responsible for monitoring, reporting, and possible action. The second is that which requires INCO support for other disciplines that may require actions, interpretations of data, or supply data for analysis.

#### INCO LCC ITEMS

SSID CT-02 S-band PM TRANSPONDER AGC Signal Strength  
TIME PERIOD EFFECTIVITY: PA HI PWR (T - 45 min) until GLS start (T - 9 min).  
INDICATIONS: Uplink signal strength lower than expected for uplink transmitter power out.

ACTIONS: Monitor uplink signal strength on active transponder. Transponder receiver uplink signal strength versus uplink transmitted power is available from previous testing. Use calibration book to determine PCM counts or call up downlink real time display to obtain PCM counts.

SSID CT-03 GCIL Active (JSC nomenclature CMD)  
TIME PERIOD EFFECTIVITY: PA HI PWR (T - 45 min) until T - 31 sec (RSLs start).  
INDICATIONS: GCIL state is PNL vice CMD.

ACTIONS: If the GCIL DID NOT revert to panel, (still on system 2 not system 1), then the vehicle will remain in the frequency selected (either HIGH or LO FREQ). A Revert To Panel Reset (KSC nomenclature is GCIL ACTIVE) command can be transmitted, and if the display indicates CMD, press for launch. If the Revert To Panel Reset (KSC nomenclature is GCIL ACTIVE) did not indicate CMD, eliminate the possibility of a

telemetry failure by using the checkout commands. If the vehicle was configured for LO FREQ and the GCIL DID revert to panel, (on system 1 vice system 2), then the vehicle will be in HIGH FREQ and downlink data will drop out. Have MILA reconfigure for HIGH FREQ operations to establish telemetry and command capability. After MILA establishes two-way lock, follow the same procedures as outlined previously.

SSID CT-04 Network Signal Processor Frame Sync Lock

TIME PERIOD EFFECTIVITY: PA HI PWR (T - 45 min) until T - 31 sec (RSLs start).

INDICATIONS: Loss of NSP frame sync lock. (Either momentary or sustained).

ACTIONS: Momentary frame sync losses may be caused by several items. Fault isolation extends from MCC-H to the vehicle. In MCC-H, can be caused by U/L FEP or timing subsystem problem or reset. Communications link (MDM's) problems can induce glitches. MILA equipment, including local configuration, can also induce glitches. Multipathing from the MILA antenna to the vehicle is a known problem. Specific action is to usually continue to monitor uplink frame sync and find the specific cause of the frame sync loss. Sustained loss of frame sync can be caused by any of the above items for momentary frame sync loss; however, multipathing will not normally cause a sustained loss. In addition, failures in the NSP/COMSEC equipment must be considered. If the NSP frame sync locks up when Encryption is bypassed, launch in the clear mode is acceptable if the GPC BLOCK SWITCH is used during non-commanding periods. Remember to advise the crew on use of the switch. Both NSP's must be functional for a launch but COMSEC capability is NOT required.

SSID CT-05 Voice Communications (S-BD A/G1 A/G2, UHF A/A, UHF A/G2)

TIME PERIOD EFFECTIVITY: Comm activation until T - 5 min

INDICATIONS: Loss of either uplink or downlink capability.

ACTIONS: Isolate to vehicle or ground problem. Total comm loss is indicative of an ACCU problem. If comm is restored by switching to ACCU, hold. UHF must also be available onboard for ascent and TAL's. For NSP MUX failures (either uplink or downlink), and if it only includes one path (A/G1 or A/G2), press for launch.

SSID CT-09 S-band Phase Modulated Power Amplifier Anomaly.

TIME PERIOD EFFECTIVITY: From PA to Hi power until T - 9 min

INDICATIONS: Loss of or degraded PA output power or elevated levels of power output.

ACTIONS: For downlink loss, go to hard-line data and determine if the PA has failed or if the transponder has failed. Either case requires a hold. For degraded performance, determine if this is a sensor failure (MILA read out of carrier downlink AGC) or actual degraded output. For sensor failure, press for launch and monitor PA temp. Degraded performance can affect TDRS acquisition if low enough (have held lock down to 60-W output). MILA can look at the spectrum and determine if the carrier has spurs. Spurs that are within 12 dBm of main carrier will cause the ground receivers to not lock. TDRS is more sensitive (spread spectrum) to spurs and is operating near threshold. This failure can be detected by MILA spectrum analyzer readout. Real elevated power output is indicative that the PA will fail in a relatively short period of time. Recommend a hold for evaluation.

SSID INS-01 Operational Instrumentation - PCM Good, TLM Down Link and Parity and Counter Good, OI and Toggle Buffer and Parity Good.

TIME PERIOD EFFECTIVITY: ET Cryo tanking (T - 6 hours) until T - 31 sec.

INDICATIONS: Improper Bite Status Register Indications or unexpected change in state of the BSR.

ACTIONS: Determine if the problem is an instrumentation failure (function is working) or a real problem (function not working). Most confirmed instrumentation failures will

be a GO for Launch. A NO GO for Launch will be called for failures in the transaction portion of the PCMMU because two of two is required. Switching PCMMU's, even if functions are restored on the alternate PCMMU, will not be a GO for Launch.

SSID INS-02 OPS Recorder Anomaly.

TIME PERIOD EFFECTIVITY: T - 9 min until T - 5 min (APU start). Only one recorder required for launch and only required to record Operational Instrumentation data and NOT Main Engine Data.

INDICATIONS: Recorder BITE, High temperature, or no tape motion.

ACTIONS: For any real problem with OPS RCDR 2, reconfigure OPS RCDR 1 for 24 IPS parallel recording. Remember problems associated with parallel recording.

For high temperature, if the temperature increased over a period of time, assume that the problem is real and take the recorder to standby. If a step function increase, assume that it is a sensor failure. Continue count; however, monitor for sticky tape. For apparent no tape motion, determine if tape percentage is incrementing at proper rate for speed selected and assume an instrumentation failure if tape percentage is incrementing.

Recorder BITE may require a recorder dump, if possible, to ascertain if a real problem or instrumentation problem. Dump would be through the FM system (reconfigured for OPS RCDR mode).

SSID INS-02a SSR Anomaly.

TIME PERIOD EFFECTIVITY: ET Cryo tanking (T-6 hours) until T - 5 min (APU start). Only one recorder required for launch and only required to record Operational Instrumentation data and NOT Main Engine Data.

INDICATIONS: Recorder Critical BITE.

ACTIONS: For any problem with any SSR, it is not necessary to reconfigure the other SSR. May be required to command a comprehensive self-test to isolate the problem. SSR BITE may require a dump, if possible, to ascertain if a real problem or instrumentation problem. Dump would be through the FM system (reconfigured for MMU 1 or 2 mode).

SSID INS-04 Operational Instrumentation (DSC)

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 5 min (APU start).

INDICATIONS: DSC BITE or parameter(s) out of limits.

ACTIONS: Determine if is a real problem (redundant power or card) or instrumentation problem. For redundant power loss, continue launch. For complete loss, hold.

Card failures require analysis of parameters lost. See LCC SSID INS-04 for required parameters.

SSID INS-05 Operational Instrumentation (MDM).

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 31 sec (RSLs start).

INDICATIONS: Wrap failure on OI MDMs.

ACTIONS: Determine if a MDM is down (no transactions). If down, request a PCMMU switch; if recovered, GO for launch. If wrap remains FAIL, power cycle the affected MDM. Remember that MDM's are grouped for power. If not recovered, hold.



LCC ITEMS THAT MAY REQUIRE INCO SUPPORT.

SSID INS-03 MTU SIGNAL Distribution.

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 31 sec (RSLs start).

INDICATIONS: DPS report of a failure either in frequency divider chain (1 or 2) or any IRIG-B channel.

ACTIONS: The loss of 1024 kHz clock means the loss of PSP commanding (PSP 1 wired to freq divider 1 and PSP 2 to freq divider 2). The divider fail indication DOES NOT mean that the 1024 kHz is bad but that one of the divider registers is bad. The BITE is driven by sensing the last register (the 1-Hz register). The frequency divider requirement is mission dependent upon requirement to command through the PSP, 1 of 2 PSP's required, 2 of 2 required, availability of IFM to rewire PSP outputs and time criticality of command capability. The only proof is to go to G9, power up the PSP(s), and send a verifiable NO-OP command to the payload. Remember that the PSP configuration message does not require the clock, only the command output register requires the clock. If the clock is not present, the PSP will display a command reject.

For an IRIG-B failure, the command uplink MUST be tested because the clock may supply time to the COMSEC unit. Any command will fail time authentication if IRIG-B time has failed to COMSEC. If the command fails, reconfigure the vehicle and ground for Encryption Bypass and test the command uplink. If command capability is regained, GO for launch (remember advise the crew on GPC BLOCK switch).

SSID DPS-03 MDM BCE BYPASS

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 31 sec (RSLs start).

INDICATIONS: Report from DPS that MDM XXX has sustained a return word BYPASS.

A BYPASS on MDM PL1 or PL2 is of special importance to INCO. Also reference SSID's DPS-19/20 and BFS-09.

ACTIONS: For any return word BYPASS, the possibility exists to take the BFS to OPS 000.

If INCO has uplinked the ascent SPC load (T - 9 min), the load will be lost and must be uplinked again.

The loss of either PL1 or PL2 has many ramifications for INCO. The loss of PL1 loses redundancy for S-band PM and FM systems, loss of control over SSR 1 or OPS RCDR 1, and Ku-band system. PL2 will lose control (including antennas and mode control) on S-band PM and FM systems and SSR 2. Remember to look at other LCC's for violations if PL1 or PL2 is lost, for instance payload system requirements.

SSID DPS-14 NETWORK SIGNAL PROCESSOR BUS CONTROL ELEMENT BYPASS

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 31 sec (RSLs start).

INDICATIONS: NSP power discretes will not generate a message and must be observed. INCO is prime for observing NSP status.

If the NSP data path is BYPASSED, a Fault Summary Message will be generated.

ACTIONS: 2 of 2 operational NSP's (voice and command) required for launch. See SSID CT-05 for A/G 1 and A/G 2 requirements.

If the power discrete for NSP 2 fails OFF but is not accompanied by a BCE message for NSP 2, NSP 2 is considered operational. Continue count.

If a BCE message is annunciated for NSP 2, NSP 2 is considered failed. A hold is required.

If the power discrete for NSP 1 fails OFF, NSP 1 is considered failed because the

GPC will not upmode to establish communications with NSP 1 without the power discrete power bit set to on. A hold is required.

**SSID DPS-18 ENGINE INTERFACE UNIT MID FREQUENCY EXECUTIVE BCE BYPASS**

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 20 min (transition to OPS 1).

INDICATIONS: DPS announcement that EIU-X has been BYPASSED.

ACTIONS: INCO verify through the attempted recovery procedure the status of MILA DECOMM lock on all three main engine data streams and report to FD/Booster/DPS. Loss of main engine data on FM or SSR 2 or OPS RCDR 1 NOT a hold for launch.

**SSID DPS-19 MDM BSR ANOMALY**

TIME PERIOD EFFECTIVITY: One time snapshot at T - 45 min

INDICATIONS: DPS announcement of MDM XXX has a failed port. Also reference SSID's DPS-03/20 and BFS-09.

ACTIONS: The loss of either PL1 or PL2 primary ports has many ramifications for INCO. The loss of PL1 loses redundancy for S-band PM and FM systems, loss of control over SSR 1 or OPS RCDR 1, and Ku-band system. PL2 will lose control (including antennas and mode control) on S-band PM and FM systems. Remember to look at other LCC's for violations if PL1 or PL2 is lost, for instance payload system requirements.

The loss of FF1 will result in the loss of command capability through NSP 1 if activated.

The loss of FF3 will result in the loss of command capability though NSP 2.

Remember both NSP's are required for launch. This includes command capability.

**SSID DPS-20 MDM BSR ANOMALY**

TIME PERIOD EFFECTIVITY: T - 6 hours until T - 10 sec (SSME start).

INDICATIONS: DPS announcement of MDM XXX has an indicated I/O failure. Also reference SSID's DPS-03/19 and BFS-09.

ACTIONS: NONE, requires the problem be fixed prior to launch. Remember that these messages are GPC mode sensitive. Flight-critical MDM's will not annunciate in G9, and the PL MDM's will not annunciate in OP1.

**SSID BFS-09 BFS PAYLOAD MDM BYPASS INDICATION.**

TIME PERIOD EFFECTIVITY: T - 18 min (transition to OPS 1) until T - 31 sec (RSLs start).

INDICATIONS: FSM I/O Error PL1/2. Also reference SSID's DPS-03/19/20 above.

ACTIONS: The loss of either PL1 or PL2 primary ports has many ramifications for INCO. The loss of PL1 loses redundancy for S-band PM and FM systems, loss of control over SSR 1 or OPS RCDR 1, and Ku-band system. PL2 will lose control (including antennas and mode control) on S-band PM and FM systems and SSR 2. Remember to look at other LCC's for violations if PL1 or PL2 is lost, for instance payload system requirements. The loss of one port (either primary or secondary) is acceptable for launch.

A complete loss of a PL MDM requires a hold.

**SSID BFS-15 BFS I/O ERROR ANOMALY**

TIME PERIOD EFFECTIVITY: T - 6 hour until T - 5 min (APU start).

INDICATIONS: FSM I/O ERROR PCM. Also reference SSID INS-01.

ACTIONS: 2 of 2 PCMMU's required for launch. May require PCMMU switch and, if a soft TFL required for launch, a TFL reload in G9.

SSID MILA-01 FORWARD LINK ANOMALY

TIME PERIOD EFFECTIVITY: T - hour 20 min until T - 31 sec (RSLs start)

INDICATIONS: Loss of forward link capability at MILA or PDL ground sites. (loss must be a ground problem not a vehicle problem).

ACTIONS: MILA mandatory for launch (system 1 or system 2).

PDL must provide either a forward link or UHF capability for launches greater than 28.5° inclination.

PDL is not required for launches at 28.5° or less inclination if MILA UHF is available.

Also covered in FLIGHT RULES section 3.

SSID MILA-02 S-BAND RETURN LINK SYSTEM ANOMALY

TIME PERIOD EFFECTIVITY: T - 5 hours 30 min until T - 31 sec (RSLs start).

INDICATIONS: Loss of MILA return link (telemetry and/or voice).

ACTIONS: MILA mandatory for launch (system 1 or system 2).

Either PDL or JDI required for launch. Also covered in FLIGHT RULES section 3.

SSID MILA-03 MILA UHF VOICE.

TIME PERIOD EFFECTIVITY: T - 1 Hour 20 min until T - 31 sec (RSLs start).

INDICATIONS: Loss of UHF voice capability. (Loss must be a ground problem not a vehicle problem.) Vehicle UHF capability required for launch (either 259.7 or 296.8 kHz and 240.0 kHz [guard frequency]).

ACTIONS: MILA UHF required for launch. MILA and Losses other than MILA covered in FLIGHT RULES section 3.

SSID SH-04 SPACEHAB DMU INTERFACE (PDI)/POWER FAILURE

TIME PERIOD EFFECTIVITY: T - 6 until T - 31 sec (RSLs start).

INDICATIONS: Loss of Master Frame Lock on PDI DECOM 1 (prime DECOMM) and/or DECOM 3. (backup DECOM).

ACTIONS: If both DECOM's lose lock and do not recover, considered as a total PDI loss. Consult flight-specific Annex Flight Rule.

If the GPC's are in G9, DECOM 4 has a sustained Master Frame Lock loss, and DECOM 2 remains in Master Frame Lock, load backup TFL for down-listing DECOM 2. If the transition to OPS 101 has occurred, continue count. Payloads will monitor secondary parameters.

SSID SH-08 SPACEHAB CABIN (ARS) HX FLOW RATE (LOW) ANOMALY>

TIME PERIOD EFFECTIVITY: T - 6 hour until T - 5 min (APU start).

INDICATIONS: Payloads Officer reports indicated loss of Spacehab H2O heat exchanger flow.

ACTIONS: Only INCO action may be to command a switch to water pump 2 and/or switch Spacehab cooling fans via uplink. This option will be exercised after the BFS has been brought up to RUN.

SSID SH-11 SPACEHAB WATER PUMP OUTLET PRESSURE (HIGH/LOW) ANOMALY>

TIME PERIOD EFFECTIVITY: T - 6 hour until T - 5 min (APU start).

INDICATIONS: Payloads Officer reports indicated Spacehab high or low H2O water pump pressure.

ACTIONS: Only INCO action may be to switch to water pump 2 via uplink. This option will be exercised after the BFS has been brought up to RUN.

**TITLE**

GENERAL INCO ASCENT/ENTRY PROCEDURES

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

This procedure will review the general activities the INCO and COMM/INST MPSR must accomplish during the ascent and entry timeframes. Only *noninclination-dependent* procedures will be included here.

The command restrictions/constraints are shown in figure 3.3-1.

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**COMMAND RESTRICTIONS/CONSTRAINTS**

1. Hazard/safety implication (should/are safed): None

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC		X		X			X			
SM										
BFS		X		X			X			
PL										
OPS 0										

2. Valid software major modes (if applicable, include OPS Mode X01, X02...):
3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: Some commands must be sent quickly to avoid excessive loss of telemetry. Crew coordination is required for NSP switches. (Fault MSG to crew.)

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**Figure 3.3-1. Command restrictions/constraints**

## PROCEDURE

### A. VOICE LOOP MONITORING DURING ASCENT/ENTRY

The ascent and entry phases of flight are considered critical phases due to the dynamic nature of the environment. These phases do not allow the luxury of time to react to situations. For this reason, it is extremely important to *minimize* voice traffic on the loops and to be completely *focused* on the INCO systems. The INCO MPSR (as well as INCO) should carefully monitor all calls to the FD and the crew to be alerted of other systems impacts on INCO systems and to maintain a “big picture” view of where the mission is heading.

During the ascent and entry phases of flight, the onboard audio system is configured to transmit on all three of the voice loops simo (A/G 1, A/G 2, and UHF). The RF COMM, DATA COMM, and INST should independently monitor these loops to detect a failure. If a failure is suspected, it should be confirmed with COMM TECH ASAP, who is also monitoring these loops. The following configuration is recommended:

RF COMM	Monitor A/G 1 only
DATA COMM	Monitor UHF only
INST	Monitor A/G 2 only

The DATA COMM and INST will verify to the RF COMM that they are hearing the crew downlink on their appropriate voice loop. The RF COMM will verify this with his loop and report to INCO. Generally, this report will be coupled with the following antenna selection verification call:

INCO COMM, three good voice and antenna selects

For the expected antenna selects during ascent, see section B.

During ascent, the following routine voice calls from the crew should be compared:

1. Roll program 7 sec
2. Go at throttle up 1 min
3. Negative return 4 min
4. Press to MECO 6 min

The calls made by the crew during entry are not as definite. The same loop monitoring configuration should be used, and a comparison should be made at the following approximate times:

1. Immediately after handover from TDRS to GSTDN
2. Landing -4 min
3. Entering the HAC

### B. ASCENT PHASE OPS

Nominal MECO will usually occur between 8M and 9M MET. Each time an engine shuts down prematurely, the MECO will be extended. Launch Digitals, which is always displayed on the left screen in the FCR (also under Master DNAV), shows the predicted MECO time, ET sep status, roll attitude, and inertial velocity ( $V_i$  ft/s). The orbiter performs a roll program immediately off the launch pad, which places it into a “heads down” configuration (180°). The orbiter may roll to a “heads up”

(RTHU) configuration part way through powered flight, based on the performance/abort scenario (see sections C 2 and 3 for abort descriptions). This RTHU is triggered by I-load velocities in the onboard guidance software. The following table summarizes the V-REL (VE) that triggers this RTHU.

Inclination	NOM, ATO, late TAL (includes TAL selected onboard after V-REL in this column)	Early TAL (TAL selected onboard prior to V- REL in previous column)
ALL	V-REL = 12.2k	V-REL = 12.2k

For all cases described above, the roll will occur at 5° per second and, thus, be complete in 36 seconds. The V-REL for both PASS and BFS are on the INCO Management display for this reason.

For RTLS aborts, the vehicle will remain heads down until powered pitch around, which occurs just prior to MECO. For all contingency aborts, the vehicle will roll heads up at variable times, depending on the scenario. For an ECAL, the vehicle will roll between about 6k and 12k (depends upon the I-load). At about 3M MET, 6k is reached, and 12k is reached no later than 8M MET.

All this information is required to determine when TDRS comm will be available because the ET interferes with TDRS comm when the line of site is within ± 20° of ET centerline on lower antennas.

More information is available in ASC G&C 2102I training manual, which is available in the training library and is recommended reading.

C. ASCENTS

1. Nominal

All launches will be conducted from KSC (PAD A or B).

COMM/INST configuration at *lift-off* will be as follows:

- S-band PM system 2
- STDN HI mode
- HDR UP+DN
- Coding UP ON/DN OFF
- FREQ LO (unless flight-specific plan requires HI)
- Encryption RCV
- NSP voice RCD ON
- FM system 1 ON (SSME mode)
- OPS 1 RCDP (7.5 IPS) (TRK 1 = CTR eng, TRK 2 = LFT eng, TRK 3 = RT eng,  
TRK 4 = nonrecoverable OD due to 192 kbps at 7.5 IPS), *OR*
- SSR 2 RCDP (3 SSME EIU's plus OD 192K)
- OPS 2 RCDA (24 IPS) (TRK 1 = OD), *OR*
- SSR 1 RCDA or RCDP (OD 192K plus OARE on EIU 1 input)
- PLR (flight specific)
- MADS recording continuous (SRB data assigned to SEQ 1 only)  
(OV103/104/105)
- OEX recorder recording (flight-specific record plan) (OV102 only)
- PCMMU 1
- TFL 129 (unless EDO or flight-specific payload requires 166)
- PDI DFL's (flight specific)
- PSP OFF
- PI OFF

ACCU 1  
ATU config -AG 1, AG 2, A/A T/R for all crewmembers  
UHF SPLX 259.7 MHz

The S-band PNL A1 will be configured as follows:

S-band PM system 1  
STDN HI  
HDR UP+DN  
Coding UP ON  
Coding DN OFF

During prelaunch operations, the ULA antenna will be selected. When the BFS is taken to run, it takes control of the payload buses, and completes the Ops 1 transition, while the antenna management program (AM) will be up and running. The default configuration for BFS AM site inhibits has MILA inhibited and PDL enabled (for plume avoidance as described later). However, PDL is not in view in AM until liftoff + 7 seconds. Thus, nominal antenna selects for early first stage are as follows:

T + 0 (lift-off)	ULA
T + 07SLLA	PDL becomes in view in AM
T + 14SLRA	During roll program
T + 21SURA	After completion of roll program

Note that even though the antennas are being selected to optimize PDL pointing, the forward link is being supported through MILA. However, early in the ascent phase, S-band to MILA experiences a period of severe plume attenuation of approximately 45 to 60 seconds. Thus, the forward link is handed over from MILA to PDL between T + 01M and T + 01M20S (*inclination dependent*). The forward link will be handed back to MILA at T + 02M30S. About 13 seconds before the MILA carrier up time (T + 02M17S), the INCO will send the BFS AM TMBU (DSM 12401) to inhibit PDL and enable MILA, which will result in a ULA antenna selection. This selection will optimize BFS antenna pointing to MILA. The downlink FEP has four sets of frame synchs set up up to process the MILA best source select telemetry (any one of MILA, JDI, or PDL telemetry sources), PDL line telemetry (still goes thru MILA), Wallops telemetry, and TDRS telemetry for the ascent phase. The final milestone for nominal ascent AM occurs just prior to MILA LOS. The nominal ascent MSPC (DSM 12101) will reconfigure the orbiter for TDRS mode at T + 07M30S. At this time, the network will hand over both links from MILA to TDRS E. Note that MILA is still AOS for up to 30 more seconds, and UHF voice should be used during the handover period. Between WLP AOS and MILA LOS, UHF will be handed over to WLP for support until WLP LOS (*inclination dependent*). Also, note that WLP can route TDRS mode telemetry until LOS, if required.

Communications will be maintained during the first ZOE to support the OMS 2 burn activity. The orbiter comm links will be handed over to TDRS Z.,

All TDRS S-band acquisitions are performed with uplink modulation ON. In the past, these acquisitions were performed with uplink modulation OFF because of concerns that modulation sidebands could cause a false lock condition. On-orbit testing during STS-71 determined that the probability of false locks was extremely low and forward link acquisitions were greatly improved, thus, the procedure was changed to modulation ON acquisitions.

During ascent, to minimize the time required to acquire/reacquire the orbiter following *site* handovers and unexpected dropouts, a configuration was developed to allow acquisitions/reacquisitions with uplink modulation ON. This requires the modulation sidebands

to be moved away from the acquisition bandwidth of the orbiter receiver. The following configuration accomplishes this:

- Uplink HDR
- Uplink coding ON
- Uplink encryption ON
- An uplink doppler bias applied at the ground stations

Should any of these conditions not be satisfied, modulation OFF acquisitions/reacquisitions must be performed. During a nominal ascent, a fixed doppler bias is applied (as documented in the NOSP 501-601 for each orbiter transponder) and is not varied. This bias allows the modulation ON acquisitions with the following exceptions:

- Following point of closest approach at WLP (negative doppler)
- During a RTLS
- At NHS

Modulation OFF acquisitions/reacquisitions must be performed in these cases.

## 2. Intact Aborts

Intact aborts are designed to provide a safe return of the orbiter to a planned landing site.

The following types of intact aborts may be called during ascent:

- |      |   |                            |
|------|---|----------------------------|
| ATO  | - | Abort to Orbit             |
| AOA  | - | Abort Once Around          |
| TAL  | - | Transoceanic Abort Landing |
| RTLS | - | Return to Launch Site      |

The type of failure and the time of the failure determine which type of abort is selected. During powered flight, the abort priorities for loss of performance are ATO, TAL, RTLS, TAL to an Augmented Contingency Landing Site (ACLS), and AOA shallow. These priorities were established to provide the highest probability of safe return of the orbiter and crew. For specific systems failures, such as a cabin leak or loss of vehicle cooling capability, the abort priorities are RTLS, TAL, and AOA. These priorities were established to provide the earliest available landing time or to avoid continuing to orbit with a loss of capability. Note that for an AOA, the abort selected onboard will be ATO. Four TAL sites are available along the west coast of Europe and Africa (Banjul, Ben Guerir, Zaragosa, and Moron) and are inclination dependent.

More information is available in ATO/AOA/TAL 2102 and RTLS Abort 2102 training manuals that are available in the training library and are highly recommended.

Analysis of the results of DTO 700-13 (STS-81 and STS-86) has determined that a viable S-band link to MILA is available during an RTLS abort scenario and a handover to TDRS is not required. Due to antenna vibrations caused by saturation effects, MILA has requested that the orbiter be taken to STDN LO for RTLS just as for entry. The SPC will reconfigure the orbiter to STDN LO at 14m. Reasonable attempts should be made to get to STDN LO for failure scenarios. If this cannot be accomplished, a courtesy call should be made to the site. If the vibrations get too severe, MILA may have to take manual control of the antenna.

## 3. Contingency Aborts



Contingency aborts are designed to provide for crew survival and probably will result in loss of the vehicle.

The following types of contingency aborts may take place during ascent:

- BAL - Bermuda abort landing
- ECAL - East coast abort landing (*high inclination only*)
- Ditch - Mode 8 egress (bailout)
- ELS - Emergency landing site (due to a TAL problem)

All cases will require a handover to TDRS prior to GSTDN LOS.

More information is available in CONT ABT 2102 training manual that is available in the training library and is recommended reading.

#### D. INCO ACTIONS DURING ASCENT PHASE

The following are INCO/COMM/INST actions during ascent phase with no comm failures. For the cases of two fuel cells and two Freon loops, you should check that the Systems AOA is still in sync with these suggested actions. *The FDF is the controlling source.* The AESP is effective from lift-off to ET-sep, and the APCL is used from ET-sep to OMS 2. Also, for any contingency procedures that take Master MADS OFF, the INST should verify the switch throw on C3, and then command MADS RCDR PWR OFF (DSM 4619).

##### 1. Nominal ascent/ATO

- |          |   |
|----------|---|
| INCO     | Command BFS AM site inhibits, as required for handovers.  |
| COMM     | Verify WAMS up to date (including MOC COMP).<br>Monitor network status.<br>Check BFS TDRS SHO vs ACQMON thru first ZOE  |
| INST     | At MECO + 06M :<br>for OV 103/104/105 -<br>MADS RCDR PWR ON (DSM 4618).<br>MADS CAL ON (DSM 4607) (wait 10 sec).<br>MADS CAL OFF (DSM 4608).<br>MADS WB OFF (DSM 4602).<br>MADS PCM OFF (DSM 4604).<br>Verify no tape motion.<br><br>MADS RCDR REW BOT (DSM 4605).<br>Wait while RCDR rewinds.<br>Verify no tape motion.<br>MADS SEQ 3 (DSM 4609).<br><br>MADS OFF/STBY (DSM 4600).<br>MADS RCDR PWR OFF (DSM 4619).<br>for OV 102 -<br>Manage the OEX system per the flight-specific plan. |
| DataComm | After MILA LOS, reconfigure the FM system:<br>FM Mode OPS RCDR (DSM 4784), OR   |

FM Mode MMU 1(2) (DSM 4728(4727)).  
At MET + 25M or per Booster's call, reconfigure OPS 1 or SSR 2:  
OPS 1 STOP (DSM 4351).  
OPS 1 AUTO INIT RST (DSM 4343).  
Verify RST (~10 sec).  
OPS 1 TRK 5 (DSM 4305).  
OPS 1 RCDA (DSM 4315).  
Verify TRK5 and FWD motion, *OR*  
SSR2 STOP PAR RCD (DSM 9336).  
Verify SSR 2 mode = RCDA.  
At dump site (*inclination dependent*) PB ascent data:  
*Remember to manage the hemi antennas; the BFS AM will not select hemi antennas when in TDRS MODE!*  
FM HEMI SEL UP/LO (if required).  
OPS 2 STOP (DSM 4451).  
OPS 2 PB SER REV (DSM 4453), *OR*  
Build queue and dump ascent data per SCP 3.30.  
*Prior* to OMS 2 or LOS (whichever comes first) :  
verify both recorders recording D + V.  
Manage the PLR per mission specific requirements.

2. AOA  
INCO  
COMM

Command BFS AM site inhibits, as required for handovers.  
Verify WAMS up to date (including MOC COMP).  
Monitor network status.  
Check TDRS SHO vs ACQMON thru landing  
Build DGS SPC when PSAT available (if applicable).  
Build AOA SPC when entry ephemeris is available.  
Verify BFS AM site inhibits for AOA site.

INST

At MECO + 10M :  
for OV 103/104/105 -  
MADS CAL ON (DSM 4607) (wait 10 sec).  
MADS CAL OFF (DSM 4608).  
*Let MADS run continuously through landing.*

for OV 102 -

Manage the OEX system per the flight-specific plan.

DataComm

*After* MILA LOS, reconfigure the FM system:  
FM Mode OPS RCDR (DSM 4784), *OR*  
FM Mode MMU 1(2) (DSM 4728(4727)).  
If due to performance, reconfigure OPS 1 **after EOT** is reached:  
OPS 1 STOP (DSM 4351).  
OPS 1 AUTO INIT RST (DSM 4343).  
Verify RST (~10 sec).  
OPS 1 TRK 4 (DSM 4305).  
OPS 1 RCDA (DSM 4315).  
Verify TRK4 and REV motion.

(No action required for SSR; it reverts to RCDA mode when SSME data area is full.)

If due to systems problems, reconfigure OPS 1 or SSR 2 per

**BOOSTER's call:**

OPS 1 STOP (DSM 4351).

OPS 1 AUTO INIT RST (DSM 4343).

Verify RST (~10 sec).

OPS 1 TRK 5 (DSM 4305).

OPS 1 RCDA (DSM 4315).

Verify TRK5 and FWD motion.

(No action required for SSR; it reverts to RCDA mode when SSME data area is full.)

At dump site (*inclination dependent*) PB ascent data:

*Remember to manage the hemi antennas; the BFS*

*AM will not select hemi antennas when in TDRS MODE!*

FM HEMI SEL UP/LO (if required).

OPS 2 STOP (DSM 4451).

OPS 2 PB SER REV (DSM 4453), *OR*

Build queue and dump ascent data per SCP 3.30.

*After dump is complete, start OPS 2:*

OPS 2 TRK SEL (use first clean track)

OPS 2 RCDA (DSM 4415).

*Let both recorders run through landing.*

Manage the PLR per mission-specific requirements.

3. TAL  
INCO

Command BFS AM site inhibits, as required for handovers.

Entry, landing, and postlanding will be performed on TDRS. Note SCP 3.103 for final antenna selection if required.

COMM

Verify WAMS up to date (including MOC COMP).

Monitor network status.

Verify INMARSAT support for UHF with COMMTECH.

INST

At MECO + 10M :

for OV 103/104/105 -

MADS CAL ON (DSM 4607) (wait 10 sec).

MADS CAL OFF (DSM 4608).

*Let MADS run continuously through landing.*

for OV 102 -

Manage the OEX system per the flight-specific plan.

DataComm

If due to performance, reconfigure OPS 1 **after EOT** is reached:

OPS 1 STOP (DSM 4351).

OPS 1 AUTO INIT RST (DSM 4343).

Verify RST (~10 sec).

OPS 1 TRK 4 (DSM 4305).

OPS 1 RCDA (DSM 4315).

Verify TRK4 and REV motion.

(No action required for SSR; it reverts to RCDA mode when SSME data area is full.)

*Let both recorders run through landing.*

If due to systems problems, reconfigure OPS 1 per **BOOSTER's call**:

OPS 1 STOP (DSM 4351).

OPS 1 AUTO INIT RST (DSM 4343).

Verify RST on (~10 sec).

OPS 1 TRK 5 (DSM 4305).

OPS 1 RCDA (DSM 4315).

Verify TRK5 and FWD motion.

(No action required for SSR; it reverts to RCDA mode when SSME data area is full.)

Manage the PLR per mission-specific requirements.

4. RTLS (*all except two fuel cells lost*)  
INCO ASAP clear SPC buffer:  
SPC BUFFER CLEAR (BFS MF)(DSM 4063).  
Uplink RTLS SPC (DSM 12103).  
Verify BFS AM site inhibit:  
if required, command PDL/MIL H/O (DSM 12401).  
COMM ASAP verify SPC buffer clear and RTLS SPC onboard.  
Notify COMMAND of the RTLS condition and that the SPC buffer has been updated (STDN LO mode @ 14 minutes).  
*Note that the uplink coding stays ON.*  
INST No action.  
DataComm No action.
5. RTLS (*two fuel cells lost*)  
INCO ASAP clear BFS SPC Buffer:  
SPC BUFFER CLEAR (BFS MF)(DSM 4063).  
Command STDN LO MODE:  
STDN LO MODE (DSM 4735)  
*Note that the uplink coding stays ON.*  
COMM ASAP verify SPC buffer clear.  
Notify COMMAND of the RTLS condition, that the SPC buffer has been cleared, and that the Orbiter is configured for STDN LO mode due to onboard problems.  
INST No action.  
DataComm No action.
6. AOA (*two freon loops lost*)  
INCO ASAP inform FD of limited TDRS Comm.  
Command BFS AM site inhibits, as required for handovers.  
If on STDN command STDN LO:  
STDN LO MODE (DSM 4735).  
*Note that the uplink coding stays ON.*

- Command the FM system OFF:  
FM PWR OFF (DSM 4781).  
Command fuel cell purge on EGIL's call (unsafe group 1).  
*Expect the comm systems to be powered down after MILA/WLP LOS.*  
*Expect no comm until UHF only at landing site AOS.*  
*Note, if S-band comm required, expect encryption bypass, HIGH FREQ (have network reconfigure), and manual antennas.*
- COMM Verify WAMS up to date (including MOC COMP).  
Monitor network status and keep them informed of onboard comm config.  
*Note that the BFS will be powered OFF.*
- INST Follow the crew procedures and inform team of upcoming events.  
Expect MASTER MADS/OEX PWR to OFF.  
for OV 103/104/105 -  
MADS RCDR PWR OFF (DSM 4619).  
for OV 102 -  
Manage the OEX system per the flight-specific plan.
- DataComm Command all recorders to STBY:  
OPS 1 STOP (DSM 4351).  
OPS 2 STOP (DSM 4451), OR  
SSR 1 HALT (DSM 9252)  
SSR 2 HALT (DSM 9352)  
PLR STOP (DSM 4551) if applicable.
7. AOA(two water loops lost).  
INCO ASAP inform flight of limited TDRS comm.  
Command BFS AM site inhibits, as required for handovers.  
If on STDN command STDN LO MODE:  
STDN LO MODE (DSM 4735).  
*Note that the uplink coding stays ON.*  
Command the FM system OFF:  
FM PWR OFF (DSM 4781).  
*Expect the comm systems to be powered down after MIL/WLP LOS.*  
*Expect no comm until V=12k (encryption bypass, HIGH FREQ (have network reconfigure), and manual antennas!).*
- COMM Verify WAMS up to date (including MOC COMP).  
Monitor network status and keep them informed of onboard comm config.  
*Note that the BFS will be powered OFF.*
- INST Follow the crew procedures and inform team of upcoming events.  
Expect MASTER MADS/OEX PWR to OFF.  
for OV 103/104/105 -  
MADS RCDR PWR OFF (DSM 4619).  
for OV 102 -  
Manage the OEX system per the flight-specific plan.
- DataComm Command all recorders to STBY:

OPS 1 STOP (DSM 4351).  
OPS 2 STOP (DSM 4451), *OR*  
SSR 1 HALT (DSM 9252)  
SSR 2 HALT (DSM 9352)  
PLR STOP (DSM 4551) if applicable.

#### E. ENTRY PHASE OPS

Entry phase begins at deorbit burn and continues through landing. Atmospheric effects are defined to start from entry interface (EI), which occurs at an altitude of 400k ft and a range from the landing site of 4300 n. mi. The generic entry profile from EI through landing is the same for all missions (not altitude dependent). The orbiter attitude at EI is purely a 40° pitch with respect to the velocity vector, not the orbiter body axis (to protect for unacceptable aerothermodynamic heating on the upper surface and wing leading edge). The 40° angle of attack is maintained down to approximately Mach 12.5. The orbiter dissipates energy via atmospheric drag and manages the energy (lift/drag) by performing a series of roll maneuvers. These maneuvers are also with respect to the velocity vector, not the orbiter body axis. Thus, these maneuvers result in a combination of *roll and yaw* rates about the orbiter body axis (which affect antenna pointing). Also, these roll commands are performed by the onboard entry guidance system.

All the inputs on the Deorbit/Entry Landing Data sheet supplied by the FDO's are **predicted** values determined by their ground entry processor (called the EPS) using atmospheric models. The first roll command occurs at approximately EI + 5 minutes and generally has a magnitude of between 60° and 85°. The direction of the first roll will always be toward the landing site with respect to the orbital ground track (i.e., if the orbital ground track passes to the west of the landing site for a descending entry, then the first roll will be to the left). The first roll makes up for almost all of the crossrange. The maximum crossrange is a mission-dependent value and is documented in the flight rule annex for each landing opportunity (it is generally between 700 and 900 n. mi.). The onboard guidance will command the next roll (first roll reversal) when the delta AZ (the heading error defined as the angle between the velocity vector and the runway) reaches its predefined boundary (I-load values known as reversal deadbands). Subsequent roll reversals work the same way. For comm purposes, the first roll and first roll reversal are the only two events to be concerned about as they impact antenna pointing to TDRS. The problem is to avoid a lower antenna selection while in the S-band blackout region (EI + 5 min to EI + 20 min). This region is caused by the plasma generated by the orbiter while passing through the upper atmosphere. This plasma mainly affects the lower quads only, but a wraparound effect may cause intermittent dropouts on the upper quads if the TDRS look angle is within an estimated 30° off the nose/tail. The subsequent roll reversals typically occur after exit of S-band blackout.

More detailed information on entry guidance may be found in the ENT GUID 2102 training manual that is available in the training library and is highly recommended.

Management of comm on TDRS for all entries into Edwards Air Force Base (EDW) and low inclination (28°) entries into Kennedy Space Center (KSC) are trivial (a loss of comm may not be avoided). This is due to the coverage of TDRS W (EDW) or the relative geometries involved (KSC - 28°). Higher inclination ( $\geq 39^\circ$ ) entries into KSC may require special comm management on TDRS, which is discussed in more detail in SCP 3.5.

#### F. ENTRY/LANDING

##### 1. General

The following things need to be considered to optimize comm coverage throughout entry and landing:

- a. Entry trajectory (direction, roll maneuvers, S-band blackout period, etc.)
- b. Inclination (TDRS handover required, TDRS to GSTDN handover time)
- c. BFS antenna management site inhibits (optimal antenna pointing)
- d. Landing site and runway (postlanding antenna selection)

The FDO constructs a deorbit landing data sheet for each entry opportunity and supplies a copy to each FCR operator on the day prior to landing. At this time, the Entry FDO nominally starts supporting for entry. Figure 3.3-2 shows an example of this data sheet. POINTING will get a copy from the FAO and work with the FDO to obtain orbiter state vector snapshots at the first roll command and the first roll reversal. Pointing will then run their processor and generate the AZ and EL for both TDRS (if in view) at each of these times. This information will be forwarded to the INCO in the form of a flight note for use in entry comm management/prediction (see SCP 3.5). Figure 3.3-3 shows an example of this flight note. INCO will subsequently generate a flight note flight note to the flight director detailing entry comm constraints; an example of this flight note is provided in Figure 3.3-4.

**It is very important to understand that the final pointing angles supplied to INCO are based on atmospheric models, and the orbiter may behave slightly differently due to the actual atmospheric conditions during entry. Thus, if the pointing angles are within about 10° of a lower antenna, it is possible that a loss of comm may occur because of a larger maneuver by onboard nav. This possibility should be identified and passed on to the FD and the crew in the flight note.**

Post wheel-stop, the INCO will inhibit BFS antenna pointing (DSM 12440) and select the appropriate S-band PM/FM upper antennas via command for postlanding operations, if required. If command is not available, the INCO will request the crew to select the appropriate PM antenna manually via the switch on C3 (this overrides the BFS AM pointing). If the S-band FM lower hemi antenna is selected and command is not available, then the INCO will request the crew select the upper hemi manually via the switch on A1L (XMIT UP/RCV LO). The upper antennas are required per the flight rule. Nominal postlanding antenna selections **to the ground station** as a function of runway for KSC/MIL and EDW/DFRC are summarized as follows:

KSC 15	Concrete	URF
KSC 33	Concrete	ULA
EDW 04	Concrete	ULA
EDW 22	Concrete	URA
EDW 15	Lakebed	URA
EDW 33	Lakebed	ULF
EDW 05R	Lakebed	ULA
EDW 23L	Lakebed	URF
EDW 18L	Lakebed	URF
EDW 36R	Lakebed	ULA
EDW 17L	Lakebed	URA
EDW 35R	Lakebed	ULF

POST-LANDING ANTENNA

Proper antennas for TDRS landings can be found in SCP 3.103. SCP 3.103 should be used for TAL's also.

DEORBIT TO KSC33 ON ORBIT 223

GENERATED MET 12/22:30

EVENT	TIME MET/CENTRAL	LAT (D:M)	LONG (D:M)	H	VEL (KFPS)	COMMENTS
DEORBIT TIG	13/22:23:40 77/06:16:40	21:06 S	127:57 E	133 NM	25.4 VI	$\Delta V = 213\text{FPS}$ $\Delta T = 2\text{M}:06\text{S}$ XRNG=+117NM INPLANE
TDRS-W AOS	13/22:13:41 77/06:06:41	37:34 S	88:02 E	141 NM	25.4 VI	EI MINUS 31 MIN
EI	13/22:44:38 77/06:37:38	29:09 N	166:00 W	399.6 KFT	24.5 VREL	RANGE 4405 NM
MACH 5	13/23:07:44 77/07:00:44	29:42 N	82:36 W	115.7 KFT	5.1 VREL	
MACH 4	13/23:08:39 77/07:01:39	29:13 N	82:02 W	102.0 KFT	4.0 VREL	
MACH 3	13/23:09:41 77/07:02:41	28:53 N	81:30 W	87.0 KFT	2.9 VREL	
MACH 2	13/23:10:42 77/07:03:42	28:47 N	81:04 W	73.4 KFT	1.9 VREL	
MACH 1	13/23:12:14 77/07:05:14	28:38 N	80:42 W	47.3 KFT	0.9 VREL	
HAC I/C	13/23:13:17 77/07:06:17	28:34 N	80:34 W	32.8 KFT	0.8 VREL	TURN ANGLE 212 DEG
LANDING	13/23:16:29 77/07:09:29					RUNWAY KSC33
ROLL SCHEDULE				ROLL (DEG)	VREL	GMT
1ST ROLL COMMAND (TO THE RIGHT)				+83	24.5	12:43:13
1ST ROLL REVERSAL (R TO L)				53 to -53	19.8	12:51:15
2ND ROLL REVERSAL (L TO R)					10.1	
3RD ROLL REVERSAL (R TO L)					4.5	

WEATHER:

CLOUDS 25 SCT 250 SCT  
VIS 7  
WINDS 2105P10

ALT 30.03  
TEMP 60°F

COMMENTS AFT 14Z WND 2110P15

FDO:E. González

**Figure 3.3-2. Sample Deorbit/Landing Data sheet**



TO: INCO  
FROM: PTG, FAO  
RE: ROLL REVERSAL ANTENNA SELECTION

---

The following TDRS look angle data is based on state vector and attitude information provided by FDO for KSC 223:

	GMT	ROLL	TDRW		TDRE	
			AZ	EL	AZ	EL
1st Roll Command	077:12:43:13	+ 80	30	- 13	(LOS)	(LOS)
1st Roll Reversal	077:12:51:15	+ 53 - 53	- 13 - 59	- 17 - 59	158 - 165	52 61

**Figure 3.3-3. Sample pointing flight note**

TO: FD, CAPCOM, GC  
FROM: INCO  
RE: ENTRY COMM SUMMARY KSC REV xxx

---

TDRS East and TDRS Z prior to the D/O burn are good for comm.

TIG is 1.5 minutes after the handover to TDRS West. Expect good comm for TIG as well.

INCO will attempt to handover TDRS satellites to avoid lower antenna selection during blackout prior to hand down to MILA.

EVENT	MET	GMT
TDRS E to Z	011/18:15: <sup>47</sup>	351/16:35: <sup>15</sup>
TDRS Z to W	011/18:27: <sup>05</sup>	351/16:46: <sup>33</sup>
TIG	011/18:28: <sup>45</sup>	351/16:48: <sup>13</sup>
TDRS W to E (1 <sup>st</sup> roll cmd)	011/19:08	351/17:28
TDRS E to W (1 <sup>st</sup> roll rev)	011/19:15	351/17:35
MILA UHF	011/19:23: <sup>33</sup>	351/17:43: <sup>01</sup>
TDRS E to MILA	011/19:24: <sup>32</sup>	351/17:44: <sup>00</sup>

**Figure 3.3-4. Sample entry COMM coverage flight note**

2. Kennedy Space Center

KSC will be the prime landing facility for all shuttle landings with few exceptions. The location of KSC/MILA with respect to TDRS W and S generates some opportunity for improved comm on higher inclination entries into KSC. These actions are discussed in SCP 3.5. KSC has one set of concrete runways (15/33).

The nominal SPC will hand down from TDRS to MILA at MILA AOS rounded to the next whole minute. The rationale for this is that it is applicable for all inclinations, all entry profiles, consistent for both runways, maximizes comm, and simplifies command procedures. Also, past performance of MILA at AOS is excellent (9-m antenna). The SPC contains two STDN LO SALVO commands (DSM 4471) sent to both P/L MDM's for redundancy. STDN LO is used because of saturation of the antenna control equipment in STDN HI. This saturation causes the antenna to vibrate. If vibration gets too severe, MILA may have to take manual control of the antenna, which is highly undesirable. When the entry ephemeris is available, the SPC should be built with the first command timetag equal to MILA AOS (rounded) and the second command timetag 1 second later to ensure proper onboard execution. Also, the BFS AM site inhibit table should be configured for landing (DSM 12420). TDRS will be used as the prime comm link through landing if MILA is unavailable.

MILA has two 9-meter antenna systems. MILA system no. 1 (MIL) has a north/south keyhole, which prevents it from being able to point at the Shuttle Landing Facility (SLF). Hence, MILA system no. 2 (MLX - east/west keyhole) is required for touchdown. For most entries, the handdown from TDRS will be to MILA system no. 1 and a handover to MILA system no. 2 will be performed as soon as reasonable after it acquires the vehicle. Some cases allow the initial handdown to be directly to MILA system no. 2, however, this is the exception, not the norm. If MILA system no. 2 is failed, landing can be performed on system no. 1. However, it may be required to have MILA increase their forward power to maintain the S-band forward link for this case.

3. Edwards Air Force Base

EDW nominally will be the backup landing facility for all shuttle landings with few exceptions. EDW has one set of concrete runways (04/22) and many sets of lakebed runways, as shown previously.

The nominal SPC will hand down from TDRS W to Dryden Flight Research Center (DFRC) at DFRC AOS + 2 minutes rounded off to the nearest whole minute. This is based on past performance of DFRC at AOS with the old 4.3m antennas. These antennas have since been upgraded to 7.3m but the handover time has not been re-addressed. The SPC contains two STDN HI SALVO commands (DSM 4472) sent to both P/L MDM's for redundancy. When the entry ephemeris is available, the SPC should be built with the first command timetag equal to DFRC AOS rounded appropriately and the rest spaced 1 second later, respectively, to ensure proper onboard execution. Also, the BFS AM site inhibit table should be configured for landing (DSM 12420). If DFRC fails, the orbiter will need to be on TDRS prior to touchdown.

4. Northrup

Northrup, also known as White Sands Space Harbor, is currently a contingency landing facility only, . It has two sets of lakebed runways only.

Landings here will be performed on TDRS W to the ground and UHF support via Salinas Peak.

G. INCO ACTIONS DURING ENTRY PHASE

The following are INCO/COMM/INST actions during entry phase with no comm failures. For any comm gear that is in an off-nominal config at convoy handover (postlanding), notify KSC (CCSE or CISL as appropriate) of the config and the rationale for it. Also, for any contingency procedures that take Master MADS OFF, the INST should verify the switch throw on C3 and then command MADS RCDR PWR OFF (DSM 4619).

1. Nominal entry/postlanding

INCO

Brief FD on the entry comm flight note.

Command BFS AM site inhibits, as required for handovers.  
At wheel stop, inhibit BFS antenna pointing (DSM 12440).  
Command the appropriate upper S-band (PM and FM) antennas,  
if required.

COMM

Verify WAMS up to date (including MOC COMP).

Build entry SPC to hand down to landing site (MILA/DFRC).  
Monitor network status.

At wheel stop, verify upper S-band (PM and FM) antennas  
selected.

INST

for OV 103/104/105 -

At TIG-1 hour, perform D/O MADS recorder checkout  
(SCP 3.28).

At TIG-15 minutes:

MADS RCDR PWR ON (DSM 4618).

MADS WB ON (DSM 4601).

MADS PCM ON (DSM 4603).

MADS CAL ON (DSM 4607) (wait 10 sec).

MADS CAL OFF (DSM 4608).

At wheel stop + 2 minutes:

MADS CAL ON (DSM 4607) (wait 10 sec).

MADS CAL OFF (DSM 4608).

At EI + 2500 seconds (~ TD + 11 minutes):

MADS RCDR PWR ON (DSM 4618).

MADS CAL ON (DSM 4607) (wait 10 sec).

MADS CAL OFF (DSM 4608).

MADS WB OFF (DSM 4602).

MADS PCM OFF (DSM 4604).

verify no tape motion.

MADS OFF/STBY (DSM 4600).

MADS RCDR PWR OFF (DSM 4619).

for OV 102 -

Manage the OEX system per the flight-specific  
command plan.

DataComm

At TIG-1H (seat ingress) configure for data+voice recording (notify  
crew):

OPS 1(2) STOP (DSM 4351(4451)).

Verify 24 IPS and motion STOP.

OPS 1(2) DATA/V RCD 192 (DSM 4360(4460)).

or RCDR VOICE 1/2 ON (DSM 4774)

and OPS 1(2) RCD SERIAL 192 (DSM 4350  
(4450)).

Verify 24 IPS and motion RUN, *OR*  
For SSR, simply command RCDR VOICE ON (DSM 4774).  
At TIG - 15M start the other recorder for simo recording through wheelstop:  
OPS 2(1) RCD SERIAL A (DSM 4415(4315)).  
Verify 24 IPS and motion RUN.  
(other SSR should already be recording)  
*Ensure that the recorders are staggered such that track turnarounds do not occur at the same time.*  
*Monitor recorder temps during entry to avoid overheating.*  
Manage PLR per mission-specific requirements.  
Postlanding configure FM for post landing recorder playback:  
FM –OPS RCDR (DSM 4784), *OR*  
FM –MMU 1(2) (DSM 4728(4727))  
Verify RF power out and proper FM MODE.  
At wheel stop + 2M, perform recorder dumps.  
Notify INCO of approximate time to complete dumps.  
All data+voice must be dumped from both OPS recorders.  
For SSR, dump only the one that was recording at TIG-1H.  
Any “old” LOS data should also be dumped.  
Some wheel stop locations may not support acceptable dump quality such as KSC 33 or structural interference at EDW. For these cases, the dumps should still be attempted.  
Manage PLR per mission-specific requirements.  
After dumps are complete configure recorders for handover to the convoy.  
For OPS RCDRS, select the next available “highest” track:  
RCD SER A (DSM 4315(4415)) to complete track selection  
Place both recorders in panel mode:  
OPS 1(2) STBY/CREW RESET (DSM 4358(4458)).  
Verify both recorders at 24 IPS, RCDA and motion RUN (PNL config), *OR*  
For SSR, continue recording but place an AUTO STOP pointer ahead of the start of recorded data that has not been dumped and verified.  
Complete postflight recorder report per SCP 3.81.

2. Contingency entry landing site other than KSC/EDW.

INCO Same procedure as nominal plus the following:  
Entry, landing, and postlanding will be performed on TDRS. Note SCP 3.103 for final antenna selection, if required.  
Brief the FD of the comm plan.

COMM Same procedure as nominal except no landing site SPC will be required.

INST Same procedure as nominal.

DataComm Perform nominal procedure up through monitoring recorder temps.

No postlanding dump will occur, so the FM can remain OFF.

Also, with no convoy support the vehicle will be safed and powered down rapidly (no cooling), so PNL mode not required either.

H. GUIDANCE LOADS DURING A/E HIGH SPEED OPS

The following guidance loads may be requested to be sent during “high-speed” ops (lift-off to MECO and EI-5 to TD). Note that the destination for all these loads is the *GNC MF*.

<u>DSM</u>	<u>LOAD TYPE</u>
40401	Delta Nav State This load performs an “additive” function to the current onboard orbiter state vector and should be sent only ONCE! It is possible that another Delta Nav State may be required to be uplinked subsequently. In this case, the GPO will delete the current 40401 and rebuild a new Delta Nav State and assign it to 40401 once again. Also note that a Delta Nav State goes “stale” very rapidly and must be uplinked ASAP after GPO requests it.
412xx	Deorbit landing site
413xx	Deorbit TACAN site

Note that an orbiter state vector is always assigned to DSM 40101 (very similar to the Delta Nav State) and should NEVER be uplinked during “high-speed” ops. The FDO's have been asked to delete 40101 from the MOC during these phases to prevent this error from occurring.

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**TITLE**

ASCENT/ENTRY COMM MALFUNCTION ACTIONS

**PURPOSE**

This procedure provides a set of INCO responses to comm system failures that occur during ascent and entry. Multiple failures in related systems (EPS, DPS, etc.) are generally not covered. Only *noninclination-dependent* actions will be included here.

The command restrictions/constraints are shown in figure 3.4-1.

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COMMAND RESTRICTIONS/CONSTRAINTS

1. Hazard/safety implication (should/are safed): LO<sub>2</sub> prevalve and overboard bleed valve commands that may be sent as a part of OMI S0007V5 Sequence 131 are safed. Catastrophic failure can occur if sent at incorrect time.

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC		X		X			X			
SM										
BFS		X		X			X			
PL										
OPS 0										

2. Valid software major modes (if applicable, include OPS Mode X01, X02....):
  3. Valid OI loads: All
  4. Vehicle, LRU/hardware version constraints: None
  5. Time constraints, crew coordination requirements: Some commands must be sent quickly to avoid excessive loss of telemetry. Crew coordination is required for NSP switches. (Fault MSG to crew.)
- 

**Figure 3.4-1. Command restrictions/constraints**

A. ASCENT COMM MALFUNCTION ACTIONS

The following assumptions are made:

- Comm and DPS systems in lift-off config (system 2 selected, etc.)
- No other comm system failures
- 1. LOSS OF D/L CARRIER (sharp cutoff)  
Command PA1 ON (DSM 4754).  
If no joy, command XPNDR1 ON (DSM 4730) (reacq required).  
If no joy, request PNL/CMD in the blind.  
If TDRS, crew will need to reconfigure PNL A1L for TDRS per APCL, p. 2-2.  
If no joy, request crew select best antenna in the blind.
- 2. STATIC FRAME (sync, no val)  
If no command available on string 1, reverse steps...  
Command NSP1 ON (DSM 4760) (notify crew to ignore fault message).  
If no joy, request crew select alternate PCMMU (FXD FMT).
- 3. LOSS OF D/L MOD (carrier no mod)  
If no command available on string 1, reverse steps...  
Command NSP1 ON (DSM 4760) (notify crew to ignore fault message).  
If no joy, command XPNDR1 ON (DSM 4730) (reacq required).  
If no joy, request PNL/CMD in the blind.  
If TDRS, crew will need to reconfigure PNL A1L for TDRS per APCL, p. 2-2.
- 4. LOSS OF NSP BIT/FRM (NO CMD or S-band voice)  
If GSTDN, request PNL/CMD prior to TDRS H/O.  
If TDRS, request PNL/CMD via UHF at next available site.  
Note that the crew may reconfigure PNL A1L for TDRS and perform a PNL/CMD prior to the next available site.
- 5. LOSS OF FF3 (NO command on NSP 2)  
If command required, request PNL/CMD.  
If TDRS, crew will need to reconfigure PNL A1L for TDRS per APCL, p. 2-2.
- 6. LOSS OF GPC 3 (NO command on NSP 2)  
If command required, request PNL/CMD.  
If TDRS, crew will need to reconfigure PNL A1L for TDRS per APCL, p. 2-2.  
Else, wait for restrung post MECO.
- 7. LOSS OF BFS TRACK ON STRING 3 (NO BFS command)  
Advise sites of nonoptimum antenna selection.  
If BFS command required, request PNL/CMD.  
If TDRS, crew will need to reconfigure PNL A1L for TDRS per APCL, p. 2-2.

8. LOSS OF BFS TRACK ON ALL STRINGS (BFS standalone) (NO BFS command)  
Monitor antenna selects and s/s - crew may need to select antennas manually (BFS nav state goes bad).  
SPC's OK.
9. BFS FAILED (fail/fail to halt) (NO BFS CMD) (NO SPC's) (GNC has PL buses)  
All except RTLS, command to TDRS real time via *two-stage* MRTC to the GNC MF  
(Assumes H/O between 10m and 11m; i.e., after RTHU)  
If nominal ascent, ATO, AOA, command MRTC DSM 1510/1511 (*inclination dependent*) to GNC MF.  
(TDRS salvo, HDR UP+DN, FLTR WD, **URF/URA**)  
If TAL, command MRTC 1510 to GNC MF.  
(TDRS salvo, HDR UP+DN, FLTR WD, **URF**)  
RTLS, command the appropriate forward antenna then to STDN LO mode (DSM 4735)  
GNC MF @ 14m or after ET sep. *Note that uplink coding stays ON.*
10. BFS TRANSIENT HALT (NO SPC's)  
Note that the BFS will come back up in OPS 0, and crew will try to recover.  
SPC gone, reuplink SPC.  
See BFS in OPS 0 action (step 11).
11. BFS IN OPS 0 (NO AM)  
Monitor antenna selects and s/s - command as required (BFS MF).  
Note: nominal TDRS E antenna = URF/URA (*inclination dependent*).  
TAL TDRS E antenna = URF.  
RTLS MILA antenna = URF/ULF (*inclination dependent*).  
SPC OK
12. LOSS OF GNC DOWNLIST  
Have DPS change downlisters (via crew item entry).  
If no joy, request crew select alternate PCMMU (FXD FMT).
13. LOSS OF BFS DOWNLIST  
If FD wants BFS downlist, request crew select alternate PCMMU (FXD FMT).
14. LOSS OF PF1 (no SSR 1 or OPS 1 cmd, no PLR cmd, no MADS/OEX cmd)  
Select MDM 2 on command panel.  
The crew will have to manage the MADS/OEX recorder via the A7L switches (post-MECO/OMS burns)
15. LOSS OF PF2 (no SSR 2 or OPS 2 cmd)  
Command ANT ELEC 1 ON (DSM 4709).  
Crew may have to dump ascent data via PNL A1R switches (on orbit).



16. LOSS OF A/G 1 D/L  

Verify no A/G 1 D/L from multiple crewmembers.  
If STDN, use A/G 2 and UHF (inform COMMTECH).  
If TDRS and NSP bite, command NSP 1 ON (DSM 4760) (inform crew of fault msg)  
If TDRS and no NSP bite, request crew select alternate ACCU.  
    If no joy, command NSP 1 ON (DSM 4760) (inform crew of fault msg).
17. LOSS OF UHF D/L CARRIER  

Verify no carrier from multiple crewmembers.  
If no joy, request crew select alternate UHF frequency (296.8 MHz).  
    Notify COMMTECH to reconfigure sites.  
If no joy, request crew take UHF PA OFF (may need squelch off at site).  
If no joy, request crew select GUARD frequency (243.0 MHz).  
    Notify COMMTECH to reconfigure sites.
18. LOSS OF UHF D/L MOD (carrier no mod)  

Verify no mod from multiple crewmembers.  
Request crew select alternate ACCU.  
If no joy, request crew select alternate UHF frequency (296.8 MHz).  
    Notify COMMTECH to reconfigure sites.
19. LOSS OF UHF U/L S/S  

Request a UHF only call  
If no joy, request crew select alternate UHF frequency (296.8 Mhz).  
    Notify COMMTECH to reconfigure sites.  
If no joy, request crew select GUARD frequency (243.0 Mhz).  
    Notify COMMTECH to reconfigure sites.
20. LOSS OF UHF U/L (good s/s)  

Request crew select alternate ACCU.  
If no joy, request crew select alternate UHF frequency (296.8 Mhz).  
    Notify COMMTECH to reconfigure sites.
21. STUCK MIKE  

Request crewmember with stuck mike cycle PTT several times.  
If no joy, request crewmember select BU (backup) on ATU.  
If no joy, (stuck button) request crewmember go back to NORM and RCV  
    on UHF (A/A) and other loops, if required, or have mic power  
    turned off.  
If joy, but UHF carrier only still on (stuck ATU) request crewmember  
    select RCV on A/A on original ATU.
22. LOSS OF MDM OF3  

Notify crew that manual antenna select will be required for TDRS.  
    Note: Nominal TDRS E antenna = URF/URA (*inclination dependent*)  
    TAL TDRS E antenna = URF.

23. LOSS OF SSR 2 or OPS 2 RCDR  
(No action for loss of SSR.)  
Reconfigure OPS 1 to record SSME and OI data.  
Command OPS 1 STOP (DSM 4351).  
Verify STBY, SPD 1, no motion.  
Command OPS 1 RCD PARALLEL (DSM 4318).
24. OPS RCDR TEMP >120° (not transducer/telemetry failure).  
Command OPS 1(2) STOP (DSM 4351(4451)).  
  
If OPS 2 reconfigure OPS 1.  
Command OPS 1 STOP (DSM 4351).  
Verify STBY, SPD 1, no motion.  
Command OPS 1 RCD PARALLEL (DSM 4318).
25. LOSS OF FM D/L (carrier no MOD or no carrier)  
Command FM XMTR 2 ON (DSM 4782).  
If no joy, monitor hemi selection (verify proper site selection).
26. PTT LOST (both RHC and HIU)  
Request crewmember select BU (backup) on ATU.  
If no joy, request crewmember go back to NORM and select VOX/VOX.
27. COMSEC 2 RCV FAIL  
If string 1 command not available, request crew select ENCR BYP on PNL A1L (notify COMMAND to reconfigure for CLR forward link).  
If STDN, request PNL/CMD prior to TDRS H/O via UHF.  
If TDRS, request PNL/CMD via UHF at next available site .  
Note that the crew may reconfigure PNL A1L for TDRS and perform a PNL/CMD prior to the next available site.
28. LOSS OF MTU IRIG B (lose T/A in COMSEC)  
If command required, request crew select ENCR BYP on PNL A1L (notify COMMAND to reconfigure for CLR forward link).

B. ENTRY COMM MALFUNCTION ACTIONS

The following assumptions are made:

- Comm and DPS systems in *entry* config (system 2 selected, etc.)
- No other comm system failures unless specified

1. LOSS OF D/L CARRIER (sharp cut-off)

If TDRS

- Command PA 1 ON (DSM 4754).
- If no joy, command XPNDR 1 ON (DSM 4730) (reacq required).
- If no joy, request a PNL/CMD in the blind.
- If comm required prior to STDN AOS the crew will need to configure PNL A1L for TDRS per EPCL, p. 2-2.

- If STDN  
Command STDN LO (DSM 4471).  
If no joy, command XPNDR 1 ON (DSM 4730) (reacq required).  
If no joy, request a PNL/CMD in the blind.  
If no joy, request crew select best antenna in the blind.
2. STATIC FRAME (sync, no val)  
  
If no command available on string 1, reverse steps...  
Command NSP 1 ON (DSM 4760) (notify crew to ignore fault message).  
If no joy, request crew select alternate PCMMU (FXD FMT).
  3. LOSS OF D/L MOD (carrier no mod)  
  
If no command available on string 1, reverse steps...  
Command NSP 1 ON (DSM 4760) (notify crew to ignore fault message).  
If no joy, command XPNDR 1 ON (DSM 4730) (reacq required).  
If no joy, request a PNL/CMD in the blind.  
If comm required prior to STDN AOS the crew will need to configure PNL A1L for TDRS per EPCL, p. 2-2.
  4. LOSS OF NSP BIT/FRM  
  
When STDN AOS, inform crew of UHF only on the U/L.  
If command or S-band voice required, request a PNL/CMD.  
Note that the crew may reconfigure PNL A1L for TDRS and perform a PNL/CMD prior to STDN AOS.
  5. LOSS OF FF3 (NO command)  
  
If command required, request PNL/CMD.  
If TDRS, crew will need to configure PNL A1L for TDRS per EPCL, p. 2-2.
  6. LOSS OF GPC (No command on NSP 2)  
  
If command required, request PNL/CMD.  
If TDRS, crew will need to configure PNL A1L for TDRS per EPCL, p. 2-2.  
Else, wait for G9 transition postlanding.
  7. LOSS OF BFS TRACK ON STRING 3 (NO BFS uplink CMD)  
  
If BFS command required, request PNL/CMD.  
If TDRS, crew will need to configure PNL A1L for TDRS per EPCL, p. 2-2.
  8. LOSS OF BFS TRACK ON ALL PASS STRINGS (BFS standalone) (NO BFS uplink CMD)  
  
Monitor antenna selects and s/s - crew may need to select antennas manually (BFS nav state goes bad).  
SPC's OK
  9. BFS FAILED (fail/fail to halt) (NO BFS CMD) (NO SPCs) (GNC has P/L buses)  
  
Command STDN mode via salvo command to the GNC MF.  
If KSC, then STDN LO (DSM 4471).  
If EDW, then STDN HI (DSM 4472).  
Command antennas via GNC MF.

10. BFS TRANSIENT HALT (NO SPC's)  
  
Note that the BFS will come back up in OPS 0 and crew will try to recover.  
SPC gone, reuplink SPC.  
See BFS in OPS 0 actions (step 11).
11. BFS IN OPS 0 (NO AM)  
  
Monitor antenna selects and s/s - command as required (BFS MF).  
SPC OK.
12. LOSS OF GNC DOWNLIST  
  
Have DPS switch downlisters (via crew item entry).  
If no joy, request crew select alternate PCMMU (FXD FMT).
13. LOSS OF BFS DOWNLIST  
  
If FD wants BFS downlist, request crew select alternate PCMMU (FXD FMT).
14. LOSS OF PF1 (no SSR 1 or OPS 1 cmd, no PLR cmd, no MADS/OEX cmd)  
  
Select MDM 2 on command panel.  
Have crew perform postlanding MADS CAL, if required.
15. LOSS OF PF2 (no SSR 2 or OPS 2 CMD)  
  
Command ANT ELEC 1 (DSM 4709)
16. LOSS OF A/G 1 D/L  
  
Verify no A/G 1 D/L from multiple crewmembers.  
If TDRS and NSP bite, command NSP 1 ON (DSM 4760) (inform crew of fault msg).  
If TDRS and no NSP bite, request crew select alternate ACCU.  
If no joy, command NSP 1 ON (DSM 4760) (inform crew of fault msg).  
If STDN use A/G 2 and UHF (inform COMMTECH).
17. LOSS OF UHF D/L CARRIER  
  
Verify no carrier from multiple crewmembers.  
If no joy, request crew select alternate UHF frequency (296.8 MHz).  
Notify COMMTECH to reconfigure sites.  
If no joy, request crew take UHF PA OFF (may need squelch off at site).  
If no joy, have crew select GUARD frequency (243.0 MHz).  
Notify COMMTECH to reconfigure sites.

18. LOSS OF UHF D/L MOD  
  
Verify no mod from multiple crewmembers.  
If no joy, request crew select alternate ACCU.  
If no joy, request crew select alternate UHF frequency (296.8 Mhz).  
Notify COMMTECH to reconfigure sites.
19. LOSS OF UHF U/L S/S  
  
Request a UHF only call.  
If no joy, request crew select alternate UHF frequency (296.8 MHz).  
Notify COMMTECH to reconfigure sites.  
If no joy, request crew select GUARD frequency (243.0 MHz).  
Notify COMMTECH to reconfigure sites.
20. LOSS OF UHF U/L (good s/s)  
  
Request crew select alternate ACCU.  
If no joy, request crew select alternate UHF frequency (296.8 MHz).  
Notify COMMTECH to reconfigure sites.
21. STUCK MIKE  
  
Request crewmember with stuck mike cycle PTT several times.  
If no joy, request crewmember select BU (backup) on ATU.  
If no joy, (stuck button) request crewmember go back to NORM and RCV on UHF (A/A) and other loops if required or have mic power turned off.  
If joy, but UHF carrier only still on (stuck ATU), request crewmember select RCV on A/A on original ATU.
22. LOSS OF MDM OF3  
  
If TDRS mode, then have crew select best antenna after STDN handover or inhibit BFS antenna pointing and command antennas manually.
23. OPS RCDR TEMP > 120° (not a transducer/telemetry failure)  
  
Command OPS 1(2) STOP (DSM 4351(4451)).
24. LOSS OF FM D/L (no carrier)  
  
Command FM XMTR 2 ON (DSM 4782).  
If no joy, monitor hemi selection (verify proper site selection).
25. PTT LOST (both RHC and HIU)  
  
Request crewmember select BU (backup) on ATU.  
If no joy, request crewmember go back to NORM and select VOX/VOX.

26. COMSEC 2 RCV FAIL

If string 1 command not available, request crew select ENCR BYP on PNL A1L (notify COMMAND to reconfigure for CLR forward link).

If TDRS, request PNL/CMD via UHF at next available site.

Note that the crew may reconfigure PNL A1L for TDRS and perform a PNL/CMD prior to the next available site.

If STDN and command required, request crew perform PNL/CMD via UHF.

27. LOSS OF MTU IRIG B (loss of T/A in COMSEC)

If command required, request crew select ENCR BYP on PNL A1L (notify COMMAND to reconfigure for CLR forward link).

**TITLE**

INCO A/E INCLINATION-SPECIFIC PROCEDURES

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

**PURPOSE**

To describe 28°, 39°, 51°, and 57° inclination ascent and entry procedures required for comm operations.

**COMMAND RESTRICTIONS/CONSTRAINTS**

These commands are valid in OPS 1, 3, and 6. Some commands must be sent quickly to avoid excessive loss of telemetry. Crew coordination is required for NSP switches (Fault MSG to crew).

**PROCEDURES**

**A. 28° INCLINATION ASCENT PROCEDURES**

1. Comm coverage up through the first ZOE will be as follows:

Note: These data are based on the STS-109 ascent profile (308 n. mi. altitude).  
The times/elevations only apply to *high altitude* (Hubble) missions.

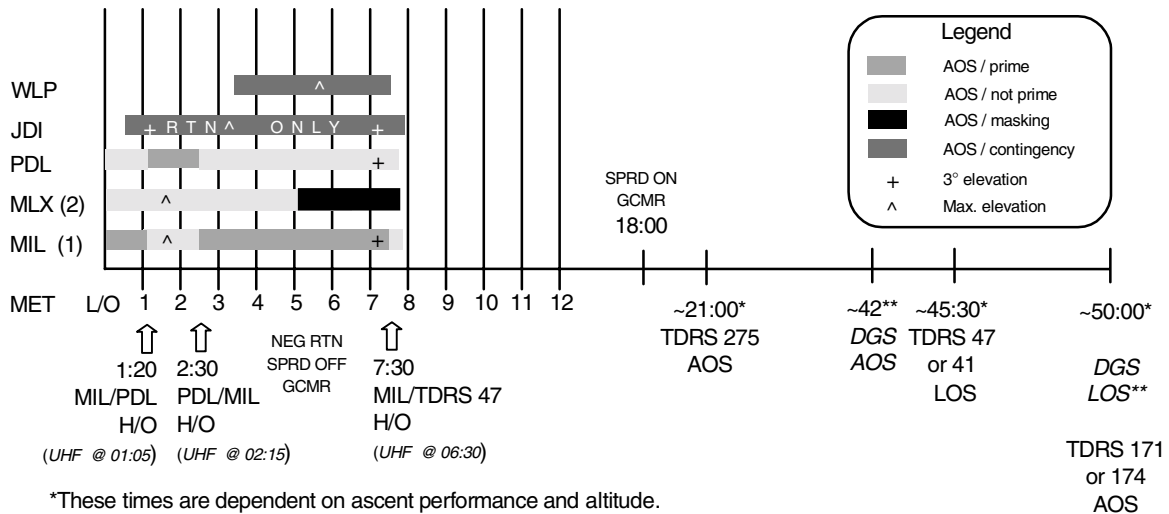


Table 3.5-1 contains the 28° detailed site data.

Table 3.5-1. 28° detailed site data

Site	MIN EL/CLR MSK	ASC 3° EL	MAX EL	Enter MSK	CLR MSK	DEC 3° EL	LOS/ENTR MSK
MIL (sys 1)	00:00/00:12	~00:15	01:37 / 40.1°	---	---	07:00	08:00
MLX (sys 2)	00:00/00:12	~00:15	01:37 / 40.1°	05:16*	*	N/A*	05:16*
PDL	~00:07	~00:15	~01:37 / 40°	---	---	~07:00	~07:48
JDI	00:30/00:36	01:01	03:15 / 20.6°	---	---	07:06	07:54
WLP	03:39	---	05:34 / 1.3°	---	---	---	07:30
TDRS 275 (Z)	21:05	---	---	---	---	---	01:17:17
TDRS 47	00:00	---	---	---	---	---	TBD
TDRS 41	00:00	---	---	---	---	---	45:26
DGSS	41:25/41:58	42:42	46:05 / 7.6°	---	---	49:29	50:21/50:48
TDRS 174	49:28	---	---	---	---	---	01:43:22
TDRS 171	TBD	---	---	---	---	---	TBD

\*Antenna keyhole - antenna stowed shortly thereafter.

2. The prime sites, handover times, and BFS Antenna Management (AM) config are as follows:

Timeframe	Event	Prime site	BFS AM config
Prelaunch	Uplink DSM 12404	MIL	PDL
1:20	Handover	MIL to PDL	PDL
<b>2:17</b>	<b>Uplink DSM 12401</b>		
2:30	Handover	PDL to MIL	MIL
7:30	Handover	MIL to TDRS 41/47	TDRS

3. Standard SPCs

12101 - TDRS at 7:30M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:07:30
2	4470	TDRS SBD SALVO	000:00:07:30
1	4759	NSP UL HDR	000:00:07:31
2	4759	NSP UL HDR	000:00:07:31
1	4764	NSP DL HDR	000:00:07:31
2	4764	NSP DL HDR	000:00:07:31
1	4766	XPNDR UL FLTR WD	000:00:07:31
2	4766	XPNDR UL FLTR WD	000:00:07:31
1	4739	SPD SPM OFF	000:00:07:31
2	4739	SPD SPM OFF	000:00:07:31

12102 - SPRD SPECTRUM ON & RANGING SPC			
MDM	DSM	TITLE	TIMEWORD
1	4738	SPD SPM ON	000:00:18:00
2	4738	SPD SPM ON	000:00:18:00
1	4745	RANGING OFF	000:00:01:20
2	4745	RANGING OFF	000:00:01:20
1	4746	RANGING ON	000:00:02:30
2	4746	RANGING ON	000:00:02:30
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

12103 - RTLS SPC			
MDM	DSM	TITLE	TIMEWORD
1	4735	STDN LO MODE	000:00:14:00
2	4735	STDN LO MODE	000:00:14:00
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

12104 - TDRS at 8M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:08:00
2	4470	TDRS SBD SALVO	000:00:08:00
1	4759	NSP UL HDR	000:00:08:01
2	4759	NSP UL HDR	000:00:08:01
1	4764	NSP DL HDR	000:00:08:01
2	4764	NSP DL HDR	000:00:08:01
1	4766	XPNDR UL FLTR WD	000:00:08:01
2	4766	XPNDR UL FLTR WD	000:00:08:01
1	4739	SPD SPM OFF	000:00:08:01
2	4739	SPD SPM OFF	000:00:08:01



These SPCs are prestored in the standard rfae\_28 directory and are built with reference to PET 1. PET 1 in the CMD server should be set to the expected lift-off time. Then these SPCs should be submitted to the CMD server. If the launch slips by more than a few seconds, the PET 1 in the CMD server should be updated and all the SPCs should be resubmitted/overwritten to adjust for the new liftoff time. Always verify the time-word associated with any SPC prior to uplinking it to the vehicle. They are sent to both P/L MDMs for redundancy. The nominal SPCs (12101 and 12102) are uplinked at about T - 8M, unless there is an expected hold at T - 5M. 12102 is the nominal SPC to turn spread spectrum back on and to optimize ranging during ascent.

12103 and 12104 are contingency SPCs. 12103 is a contingency SPC that is used for an RTLS case (note that uplink coding will stay ON). 12104 is a contingency SPC that is used for a TDRS down case.

28° contingency SPC procedures are as follows:

**RTLS**

CLEAR nominal SPCs (12101/2) and uplink 12103.

**TDRS down**

CLEAR nominal SPCs (12101/2) and uplink 12104 and reuplink 12102.

*If post SRB sep, verify RANGING config and cmd OFF if required.*

**Performance problem/ditch case**

Monitor GSTDN antenna elevation and, if it drops to 5° prior to 7M, consider commanding to TDRS early via MRTC.

4. 28° Standard MRTCs

These commands are used if it is required to command to TDRS real time (BFS or SPC problem). All MRTCs should be sent via **two-stage execute**. The SS ON commands are available if required (GCMR failure, RTLS+MILA failure, RTLS turns into ditch, etc.).

- 1510 - TDRS SS OFF  
(SALVO + UL HDR + DL HDR + UL FLTR WD + SS OFF)  
This is used to command to TDRS with spread spectrum OFF when antenna selection is not required (i.e., BFS AM is selecting correctly).
- 1512 - TDRS URF SS OFF  
(SALVO + UL HDR + DL HDR + UL FLTR WD + SS OFF + URF)  
This is used to command to TDRS with spread spectrum OFF and select the appropriate post-RTHU antenna (URF) for the nominal, ATO, and TAL ascent cases (BFS problem).
- 4769 - TDRS SS ON  
(SALVO + UL HDR + DL HDR + UL FLTR WD)  
This is used to command to TDRS with spread spectrum ON (network GCMR failed, etc.) when antenna selection is not required (i.e., BFS AM is selecting correctly).
- 1514 - TDRS URF SS ON  
(SALVO + UL HDR + DL HDR + UL FLTR WD + URF)  
This is used to command to TDRS with spread spectrum ON (network GCMR failed) and select the appropriate post-RTHU antenna (URF) for the nominal, ATO, and TAL ascent cases (BFS problem).

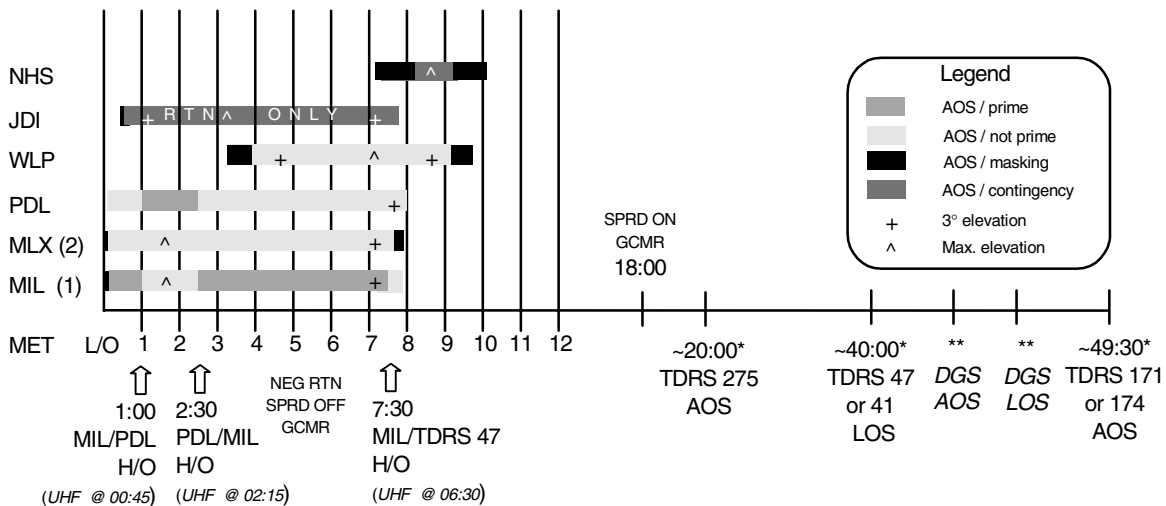
B. 28° INCLINATION ENTRY PROCEDURES

The INCO should evaluate the predicted TDRS AZ and EL angles received from POINTING to determine if a lower antenna will be selected during the S-band blackout period. If this situation is predicted, the expected loss of comm times should be passed on to the Flight Director and the rest of the controllers (and possibly the crew).

C. 39° INCLINATION ASCENT PROCEDURES

1. Comm coverage up through the first ZOE will be as follows:

Note: These data are based on the STS-107 ascent profile (150 n. mi. insertion altitude).  
The times/elevations will vary slightly on a mission-specific basis.



\*These times are dependent on ascent performance and altitude.  
These times should be compared to ACQMON periodically post-MECO.  
\*\*DGS will be available only for high altitude missions at this inclination.

Table 3.5-2 contains the 39° detailed site data.

**Table 3.5-2. 39° detailed site data**

Site	MIN EL / CLR MASK	Enter MSK	CLR MSK	ASC 3° EL	MAX EL	DEC 3° EL	ENTR MASK / MIN EL
MIL (sys 1)	00:00/00:12	---	---	~00:18	01:37 / 37.9°	07:06	--/07:54
MLX (sys 2)	00:00/00:12	---	---	~00:18	01:37 / 37.9°	07:06	07:42/07:54
PDL	~00:07	---	---	~00:12	~01:37 / 37°	~07:12	~08:00
JDI	00:30/00:36	---	---	01:07	03:08 / 16.0°	06:53	--/07:48
WLP	03:15/03:57	---	---	04:46	07:00 / 6.0°	08:46	09:02/09:44
NHS	07:12/08:19	---	---	---	08:47 / 1.4°	---	09:13/10:05
TDRS 275 (Z)	20:06	---	---	---	---	---	01:11:27
TDRS 47	00:00	---	---	---	---	---	TBD
TDRS 41	00:00	---	---	---	---	---	40:06
DGSS	39:43/39:45	40:16	40:27	40:37	43:24 / 10°	46:09	46:46/47:05
TDRS 174	49:32	---	---	---	---	---	01:41:36
TDRS 171	TBD	---	---	---	---	---	TBD

2. The prime sites, handover times, and BFS AM config are as follows:

Timeframe	Event	Prime site	BFS AM config
Prelaunch	Uplink DSM 12404	MIL	PDL
1:00	Handover	MIL to PDL	PDL
<b>2:17</b>	<b>Uplink DSM 12401</b>		
2:30	Handover	PDL to MIL	MIL
7:30	Handover	MIL to TDRS 41/47	TDRS

3. 39° standard SPCs

12101 - TDRS at 7:30M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:07:30
2	4470	TDRS SBD SALVO	000:00:07:30
1	4759	NSP UL HDR	000:00:07:31
2	4759	NSP UL HDR	000:00:07:31
1	4764	NSP DL HDR	000:00:07:31
2	4764	NSP DL HDR	000:00:07:31
1	4766	XPNDR UL FLTR WD	000:00:07:31
2	4766	XPNDR UL FLTR WD	000:00:07:31
1	4739	SPD SPM OFF	000:00:07:31
2	4739	SPD SPM OFF	000:00:07:31

12102 - SPRD SPECTRUM ON & RANGING SPC			
MDM	DSM	TITLE	TIMEWORD
1	4738	SPD SPM ON	000:00:18:00
2	4738	SPD SPM ON	000:00:18:00
1	4745	RANGING OFF	000:00:01:00
2	4745	RANGING OFF	000:00:01:00
1	4746	RANGING ON	000:00:02:30
2	4746	RANGING ON	000:00:02:30
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

12103 - RTLS SPC			
MDM	DSM	TITLE	TIMEWORD
1	4735	STDN LO MODE	000:00:14:00
2	4735	STDN LO MODE	000:00:14:00
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

12104 - TDRS @ 9M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:09:00
2	4470	TDRS SBD SALVO	000:00:09:00
1	4759	NSP UL HDR	000:00:09:01
2	4759	NSP UL HDR	000:00:09:01
1	4764	NSP DL HDR	000:00:09:01
2	4764	NSP DL HDR	000:00:09:01
1	4766	XPNDR UL FLTR WD	000:00:09:01
2	4766	XPNDR UL FLTR WD	000:00:09:01
1	4739	SPD SPM OFF	000:00:09:01
2	4739	SPD SPM OFF	000:00:09:01

These SPCs are prestored in the standard rfae\_39 directory and are built with reference to PET 1. PET 1 in the CMD server should be set to the expected lift-off time. Then these SPCs should be submitted to the CMD server. If the launch slips by more than a few seconds, the PET 1 in the CMD server should be updated and all the SPCs should be resubmitted/overwritten to adjust for the new liftoff time. Always verify the time-word associated with any SPC prior to uplinking it to the vehicle. They are sent to both P/L MDMs for redundancy. The nominal SPCs (12101 and 12102) are uplinked at about T - 8M, unless there is an expected hold at T - 5M. 12102 is the nominal SPC to turn spread spectrum back on and optimize ranging during ascent.

12103 and 12104 are contingency SPCs. 12103 is a contingency SPC that is used for an RTLS case (note that uplink coding stays ON). 12104 is a contingency SPC that is used for a TDRS down case.

39° contingency SPC procedures are as follows:

**RTLS**

CLEAR nominal SPCs (12101/2) and uplink 12103.

**TDRS down**

CLEAR nominal SPCs (12101/2) and uplink 12104 and reuplink 12102 (*If post SRB sep, verify RANGING config and cmd OFF if required.*). Hand over links from MILA to WLPS to extend coverage.

**Performance problem/Ditch case**

Monitor GSTDN antenna elevation and if it drops to 5° prior to 7M, consider commanding to TDRS early via MRTC.

4. 39° standard MRTCs

Same as 28° inclination procedures. (See Section A of this SCP.)

D. 39° INCLINATION ENTRY PROCEDURES

The INCO should evaluate the predicted TDRS AZ and EL angles received from POINTING to determine if a lower antenna will be selected during the S-band blackout period. It is possible that for certain 39° entries into KSC, communications with the orbiter may be slightly increased by handing over from the Western TDRS (171° or 174°) to an Eastern TDRS (41° or 47°) at the appropriate time prior to MILA AOS. Orbiter roll maneuvers that occur during the period normally associated with S-band blackout may allow an increased AOS period if antenna pointing can be maintained through an upper antenna.

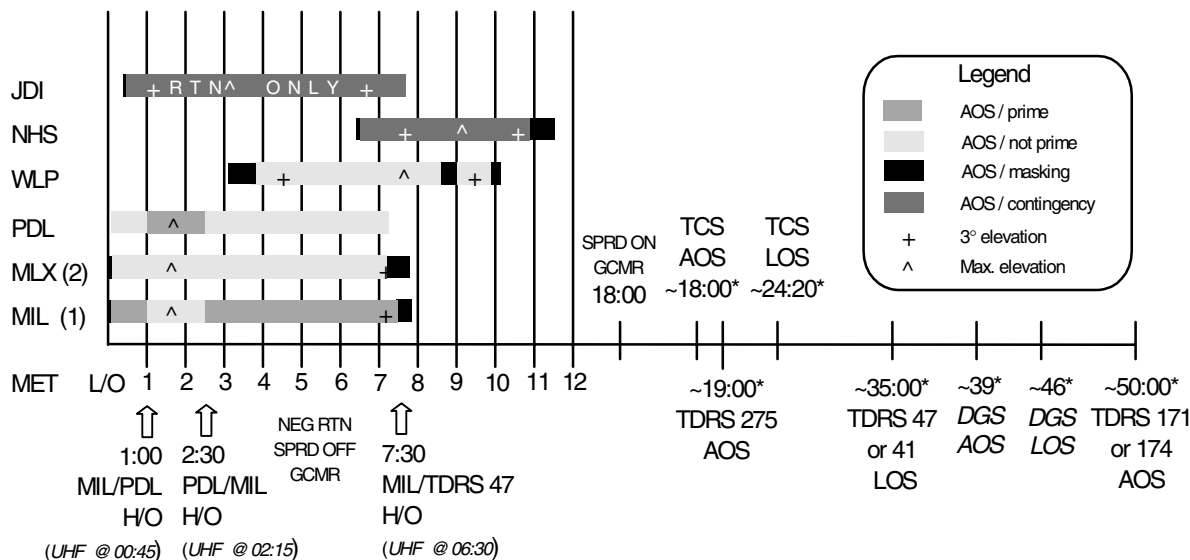
If it is determined that a handover to TDRS 47° or 41° is beneficial,

1. INCO determines the time at which the handover will occur. Generally this is about 30 seconds prior to the expected time of the appropriate roll command.
2. INCO notifies the Flight Director and the rest of the controllers (and possibly the crew) of the expected loss of comm times and that a handover from the Western TDRS to the Eastern TDRS will be attempted to increase the comm coverage. The time of the expected handover is also passed on to the flight control team (and possibly the crew).
3. INCO builds a TDRS 47° or 41° vector for slot 1.
4. INCO/COMM Supt notifies COMMAND of the expected handover time.
5. INCO uplinks the new TDRS vector to the BFS TWO-STAGE BUFFER via the **manual execute** option several minutes prior to the expected handover time.
6. At the planned handover time, the INCO sends the TWO-STAGE BUFFER EXECUTE to force the BFS to select the antenna for the Eastern TDRS. Comm should be restored as soon as the orbiter roll places the Eastern TDRS on an upper antenna.
7. The nominal SPC will hand down to the ground site at the appropriate time (site dependent).

E. 51° INCLINATION ASCENT PROCEDURES

- Comm coverage up through the first ZOE is as follows:

Note: These data are based on the STS-108 ascent profile (122 n. mi. insertion altitude).  
The times/elevation vary slightly on a mission-specific basis.



\*These times are dependent on ascent performance and altitude.  
These times should be compared to ACQMON periodically post-MECO.

Table 3.5-3 contains the 51° nominal detailed site data, and Table 3.5-4 contains the 51° TAL detailed site data.

**Table 3.5-3. 51° nominal detailed site data**

Site	MIN EL/ CLR MSK	ASC 3° EL	MAX EL	Enter MSK	CLR MSK	DEC 3° EL	Enter MSK/ MIN EL
MILS (sys 1)	00:00/00:12	~00:18	01:37 / 37°	---	---	06:53	07:30/07:48
MLXS (sys 2)	00:00/00:12	~00:18	01:37 / 37°	---	---	06:53	07:18/07:48
PDLS	~00:07	~00:12	~01:43/37°	---	---	~07:12	~07:12
JDIS	00:30/00:36	01:07	03:08 / 14°	---	---	06:41	07:36
WLPS	03:08/03:51	04:34	07:36 / 11°	08:37*	09:00*	09:22	09:57/10:10
NHSS	06:29/06:35	07:42	09:09 / 7°	---	---	10:35	10:52/11:29
TCSS	17:35/18:14	18:14	20:49 / 65°	---	---	23:42	24:19/24:26
TDRS 275 (Z)	19:01	---	---	---	---	---	01:07:39
TDRS 47	00:00	---	---	---	---	---	TBD
TDRS 41	00:00	---	---	---	---	---	35:38
DGSS	38:52/39:00	39:33	42:45 / 69°	---	---	45:55	46:21/46:39
TDRS 174	49:28	---	---	---	---	---	01:39:54
TDRS 171	TBD	---	---	---	---	---	TBD

\*WLPS midpass masking (antenna keyholes) has been verified as capable of providing excellent return link (STS-74), and it is expected to support acceptable forward link also. The ascent comm plan no longer avoids this keyhole. WLPS has a new 11m antenna system with no keyhole concerns, however, Shuttle support has not yet been transitioned from the 9m to the 11m. Shuttle transition is currently under "study".

Table 3.5-4. 51° TAL detailed site data

Site	AOS/CLR MSK / AOS EL	Enter MSK	CLR MSK	Enter MSK/LOS/ LOS EL
<b>Prime TAL ZARAGOSA</b>				
MILS	00:04 / 0.3°	----	----	09:49 / 0.0°
MLXS	00:16 / 3.2°	----	----	09:14 / 1.7°
WLPS	03:48 / 1.4°	<b>10:48 / 6.5°</b>	<b>12:04 / 0.8°</b>	12:08 / 0.6°
NHSS	07:16 / 0.2°	----	----	12:36 / 2.1°
<b>1st ALT TAL MORON</b>				
MILS	00:04 / 0.3°	----	----	09:54 / 0.0°
MLXS	00:16 / 3.2°	----	----	09:18 / 1.7°
WLPS	03:49 / 1.4°	<b>10:53 / 6.4°</b>	<b>12:09 / 0.8°</b>	12:13 / 0.5°
NHSS	07:20 / 0.2°	----	----	12:41 / 2.1°
<b>2nd ALT TAL BEN GUERIR</b>				
MILS	00:04 / 0.3	----	----	09:53 / 0.0
MLXS	00:16 / 3.2	----	----	09:23 / 1.5
WLPS	03:49 / 1.4	----	----	11:00 / 5.0
NHSS	07:19 / 0.1	----	----	12:29 / 1.7

2. The prime sites, handover times, and BFS AM config are as follows:

Timeframe	Event	Prime site	BFS AM config
Prelaunch	Uplink DSM 12404	MIL	PDL
1:00	Handover	MIL to PDL	PDL
<b>2:17</b>	<b>Uplink DSM 12401</b>		
2:30	Handover	PDL to MIL	MIL
7:30	Handover	MIL to TDRS 41/47	TDRS

3. 51° Standard SPCs

12101 - TDRS at 7:30M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:07:30
2	4470	TDRS SBD SALVO	000:00:07:30
1	4759	NSP UL HDR	000:00:07:31
2	4759	NSP UL HDR	000:00:07:31
1	4764	NSP DL HDR	000:00:07:31
2	4764	NSP DL HDR	000:00:07:31
1	4766	XPNDR UL FLTR WD	000:00:07:31
2	4766	XPNDR UL FLTR WD	000:00:07:31
1	4739	SPD SPM OFF	000:00:07:31
2	4739	SPD SPM OFF	000:00:07:31

12102 - SPRD SPECTRUM ON & RANGING SPC			
MDM	DSM	TITLE	TIMEWORD
1	4738	SPD SPM ON	000:00:18:00
2	4738	SPD SPM ON	000:00:18:00
1	4745	RANGING OFF	000:00:01:00
2	4745	RANGING OFF	000:00:01:00
1	4746	RANGING ON	000:00:02:30
2	4746	RANGING ON	000:00:02:30
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

12103 - RTLS SPC			
MDM	DSM	TITLE	TIMEWORD
1	4735	STDN LO MODE	000:00:14:00
2	4735	STDN LO MODE	000:00:14:00

12104 - SGLS @ 10M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4473	SGLS SALVO (NHS)	000:00:10:00
2	4473	SGLS SALVO (NHS)	000:00:10:00
1	4738	SPD SPM ON	000:00:18:00
2	4738	SPD SPM ON	000:00:18:00

12105 - TDRS @ 11:25MSPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:11:25
2	4470	TDRS SBD SALVO	000:00:11:25
1	4759	NSP UL HDR	000:00:11:26
2	4759	NSP UL HDR	000:00:11:26
1	4764	NSP DL HDR	000:00:11:26
2	4764	NSP DL HDR	000:00:11:26
1	4766	XPNDR UL FLTR WD	000:00:11:26
2	4766	XPNDR UL FLTR WD	000:00:11:26
1	4739	SPD SPM OFF	000:00:11:26
2	4739	SPD SPM OFF	000:00:11:26

12106 - TDRS DOWN SPC - PF1			
MDM	DSM	TITLE	TIMEWORD
1	4473	SGLS SALVO (OTS)	000:00:18:00
1	4470	TDRS SBD SALVO	000:00:25:00
1	4759	NSP UL HDR	000:00:25:01
1	4764	NSP DL HDR	000:00:25:01
1	4766	XPNDR UL FLTR WD	000:00:25:01
1	4473	SGLS SALVO (DGS)	000:00:38:30
1	4470	TDRS SBD SALVO	000:00:48:00
1	4759	NSP UL HDR	000:00:48:01
1	4764	NSP DL HDR	000:00:48:01
1	4766	XPNDR UL FLTR WD	000:00:48:01

12107 - TDRS DOWN SPC - PF2			
MDM	DSM	TITLE	TIMEWORD
2	4473	SGLS SALVO (OTS)	000:00:18:00
2	4470	TDRS SBD SALVO	000:00:25:00
2	4759	NSP UL HDR	000:00:25:01
2	4764	NSP DL HDR	000:00:25:01
2	4766	XPNDR UL FLTR WD	000:00:25:01
2	4473	SGLS SALVO (DGS)	000:00:38:30
2	4470	TDRS SBD SALVO	000:00:48:00
2	4759	NSP UL HDR	000:00:48:01
2	4764	NSP DL HDR	000:00:48:01
2	4766	XPNDR UL FLTR WD	000:00:48:01

12108 - TDRS AT TCS LOS SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:25:00
2	4470	TDRS SBD SALVO	000:00:25:00
1	4759	NSP UL HDR	000:00:25:01
2	4759	NSP UL HDR	000:00:25:01
1	4764	NSP DL HDR	000:00:25:01
2	4764	NSP DL HDR	000:00:25:01
1	4766	XPNDR UL FLTR WD	000:00:25:01
2	4766	XPNDR UL FLTR WD	000:00:25:01
-	-	-	-
-	-	-	-

These SPCs are prestored in the standard rfae\_51 directory and are built with reference to PET 1. PET 1 in the CMD server should be set to the expected lift-off time. Then, these SPCs should be submitted to the CMD server. If the launch slips by more than a few seconds, the PET 1 in the CMD server should be updated and all the SPCs should be resubmitted/overwritten to adjust for the new liftoff time. Always verify the time-word associated with any SPC prior to uplinking it to the vehicle. The SPCs are sent to both P/L MDMs for redundancy, except for 12106, 12107. 12106 and 12107 are sent to single P/L MDMs because of the 25 command restriction in the onboard SPC buffer. The nominal SPCs (12101 and 12102) are uplinked at about T - 8M, unless there is an expected hold at T - 5M. 12102 is the nominal SPC to turn spread spectrum back on and optimize ranging during ascent.

12103 through 12108 are contingency SPCs. 12103 is used for an RTLS case (note that uplink coding stays ON). 12104, 12105, and 12106 are used for a TDRS down case. 12107 is used for a TDRS down case combined with a P/L MDM 1 problem. 12108 is used if the crew does a PNL/CMD or SGLS item entry at TCS.

51° contingency SPC procedures are as follows:

**RTLS**

CLEAR nominal (12101/2) SPCs and uplink 12103.

**TDRS down**

CLEAR nominal SPC's (12101/2) post SRB sep, uplink 12104, 12105, and 12106 (if PF1 is not available, uplink 12107 instead of 12106). Have command manage forward link, as required (WLPS and NHSS).

*REMEMBER TO GCMR NETWORK FOR SS ON DURING TCS IF REQD.*

**East Coast Abort Landing (ECAL)**

Monitor GSTDN antenna elevation and if it drops to 5° prior to 7M, consider commanding to TDRS early via MRTC.

**PNL/CMD or SGLS item entry at TCS**

Uplink 12108 prior to TCS LOS.

*REMEMBER TO GCMR NETWORK FOR SS ON DURING TCS IF REQD.*

4. 51° standard MRTCs

These commands are used if it is required to command to TDRS real time (BFS or SPC problem). All MRTCs should be sent via **two-stage execute**. The SS ON commands are available if required (GCMR failure, RTLS+MILA failure, RTLS turns into ditch, etc.).

- 1510 - TDRS SS OFF  
(SALVO + UL HDR + DL HDR + UL FLTR WD + SS OFF)  
Used to command to TDRS with spread spectrum OFF when antenna selection is not required (i.e., BFS AM is selecting correctly).
- 1511 - TDRS URA SS OFF  
(SALVO + UL HDR + DL HDR + UL FLTR WD + SS OFF + URA)  
Used to command to TDRS with spread spectrum OFF and to select the appropriate post-RTHU antenna (URA) for the nominal and ATO ascent cases (BFS problem).
- 1512 - TDRS URF SS OFF  
(SALVO + UL HDR + DL HDR + UL FLTR WD + SS OFF + URF)  
Used to command to TDRS with spread spectrum OFF and to select the appropriate post-RTHU antenna (URF) for the TAL ascent case (BFS problem).
- 4769 - TDRS SS ON  
(SALVO + UL HDR + DL HDR + UL FLTR WD)  
Used to command to TDRS with spread spectrum ON (network GCMR failed) when antenna selection is not required (i.e., BFS AM is selecting correctly).
- 1513 - TDRS URA SS ON  
(SALVO + UL HDR + DL HDR + UL FLTR WD + URA)  
Used to command to TDRS with spread spectrum ON (network GCMR failed) and to select the appropriate post-RTHU antenna (URA) for the nominal and ATO ascent cases (BFS problem).
- 1514 - TDRS URF SS ON  
(SALVO + UL HDR + DL HDR + UL FLTR WD + URF)  
Used to command to TDRS with spread spectrum ON (network GCMR failed) and to select the appropriate post-RTHU antenna (URF) for the TAL ascent case (BFS problem).



5. 51° East Coast Abort Landing

The following abort sites have been identified (ref ASC C/L for flight-specific sites):

- a. Wilmington, North Carolina (ILM)
- b. Cherry Point, North Carolina (NKT)
- c. Oceana, Virginia (NTU)
- d. Wallops, Virginia (WAL)
- e. Atlantic City, New Jersey (ACY)
- f. Gabreski, Long Island New York (FOK)
- g. Otis, Massachusetts (FMH)
- h. Pease, New Hampshire (PSM)
- i. Halifax, Nova Scotia/Canada (YHZ)
- j. Stephenville, Newfoundland/Canada (YJT)
- k. St John's, Newfoundland/Canada (YYT)
- l. Gander, Newfoundland/Canada (YQX)

To maximize communications for these abort landings, TDRS 41 or 47 must eventually be used. Ground station coverage will be reduced since the vehicle will be much lower in altitude. The goal is to select TDRS 41 or 47 as soon as possible once the vehicle is "heads up" but before ground station coverage ends. Based on simulations and knowledge of expected roll profiles for ECAL scenarios, a handover from GSTDN to TDRS of 7:30 MET will work in most cases. This time should be before MILA or Wallops LOS but after roll to "heads up." Therefore, the following procedure should be followed:

- a. Monitor the FD loop for FDO's call, "2 out second stage." This call implies that an ECAL is likely to be attempted. It should be followed with the target site.
- b. Verify that the TDRS Spread Spectrum OFF GCMR has been sent.
- c. Uplink a 41 or 47 TDRS state vector to slot 1. This protects antenna pointing if 171 or 174 unexpectedly comes into view (inaccurate BFS nav).
- d. Notify COMMAND to have MILA report elevation angle above horizon in 1° steps, beginning when the vehicle is 10° high.
- e. If the vehicle is expected to go below the horizon prior to 7:30 MET and Wallops has acquired, handover to Wallops. If Wallops has not acquired, command to TDRS in real time via MRTC.
- f. Monitor Launch Digitals for roll angle and Antenna Management for TDRS look angles and notify FD if TDRS acquisition is uncertain (because of still being "heads down").
- g. FDO is responsible for notifying GSFC FDF of the probable landing site. GSFC will attempt to send an Earth-fixed vector to WSGT to point the TDRS at the landing site.

F. 51° INCLINATION ENTRY PROCEDURES

The INCO should evaluate the predicted TDRS AZ and EL angles received from POINTING to determine if a lower antenna will be selected during the S-band blackout period.

It has been determined that for certain 51° inclination entries into KSC, communications with the orbiter can be significantly increased by handing over from the Western TDRS (171° or 174°) to an Eastern TDRS (41° or 47°) before MIL AOS. Orbiter roll maneuvers that occur during the period normally associated with S-band blackout may allow an increased AOS period if antenna pointing can be maintained through an upper quad.

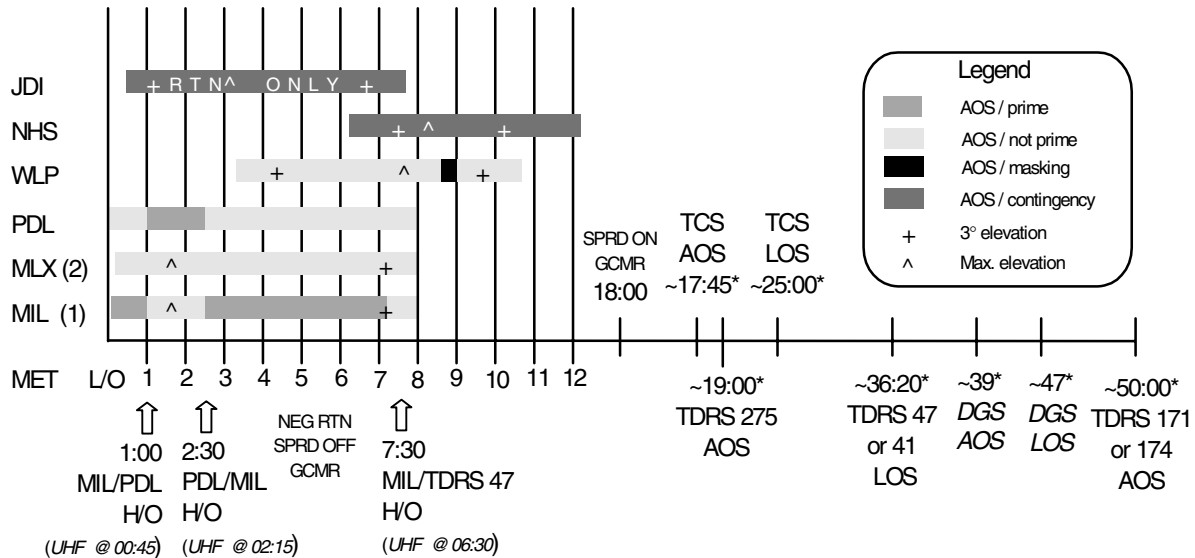
If it is determined that a handover to TDRS 47° or 41° is beneficial,

1. INCO determines the time at which the handover will occur. Generally, this is about 30 seconds prior to the expected time of the appropriate roll cmd.
2. INCO notifies the Flight Director and the rest of the controllers (and possibly the crew) of the expected loss of comm times and that a handover from the Western TDRS to the Eastern TDRS will be attempted to increase the comm coverage. The time of the expected handover is also be passed on to the flight control team (and possibly the crew).
3. INCO/COMM builds a TDRS 47° or 41° vector for slot 1.
4. INCO/COMM Supt notifies COMMAND of the expected handover time.
5. INCO uplinks the new TDRS vector to the BFS TWO-STAGE BUFFER via the **manual execute** option several minutes prior to the expected handover time.
6. At the planned handover time, the INCO sends the TWO-STAGE BUFFER EXECUTE to force the BFS to select the antenna for the Eastern TDRS. Comm should be restored as soon as the orbiter roll places the Eastern TDRS on an upper antenna.
7. The nominal SPC will hand down to the ground site at the appropriate time (site dependent).

G. 57° INCLINATION ASCENT PROCEDURES

1. Comm coverage up through the first ZOE will be as follows:

Note: These data are based on the STS-56 ascent profile (160 n. mi. altitude).  
The times/elevations will vary slightly on a mission-specific basis.



\*These times are dependent on ascent performance and altitude.  
These times should be compared to ACQMON periodically post-MECO.

Table 3.5-5 contains the 57° detailed site data.

**Table 3.5-5. 57° Detailed site data**

Site	MIN EL/ CLR MSK	ASC 3° EL	MAX EL	DEC 3° EL	Enter MSK/ MIN EL
MILS (sys 1)	00:06	~00:12	01:43 / 37.8°	07:12	08:06
MLXS (sys 2)	00:18	~00:12	01:43 / 37.8°	07:12	08:06
PDLS	00:07	~00:12	~01:43 / 37°	~07:12	~08:00
JDIS	00:36	01:07	03:15 / 14.3°	06:47	07:48
WLPS	03:33	04:21	07:48 / 22.7°	09:56	10:42
NHSS	06:23	07:24	08:20 / 16.5°	10:20	12:17
TCSS	17:36	18:19	21:04 / 19.4°	24:12	25:00
TDRS 275 (Z)	~19:00	---	---	---	TBD
TDRS 47	00:00	---	---	---	TBD
TDRS 41	00:00	---	---	---	~36:20
DGSS	~39:00	TBD	TBD	TBD	~47:00
TDRS 174	~50:00	---	---	---	TBD
TDRS 171	TBD	---	---	---	TBD

2. The prime sites, handover times, and BFS AM config are as follows:

Timeframe	Event	Prime site	BFS AM config
Prelaunch	Uplink DSM 12404	MIL	PDL
1:00	Handover	MIL to PDL	PDL
<b>2:17</b>	<b>Uplink DSM 12401</b>		
2:30	Handover	PDL to MIL	MIL
7:30	Handover	MIL to TDRS 41/47	TDRS

3. 57° Standard SPCs

12101 - TDRS at 7:30M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:07:30
2	4470	TDRS SBD SALVO	000:00:07:30
1	4759	NSP UL HDR	000:00:07:31
2	4759	NSP UL HDR	000:00:07:31
1	4764	NSP DL HDR	000:00:07:31
2	4764	NSP DL HDR	000:00:07:31
1	4766	XPNDR UL FLTR WD	000:00:07:31
2	4766	XPNDR UL FLTR WD	000:00:07:31
1	4739	SPD SPM OFF	000:00:07:31
2	4739	SPD SPM OFF	000:00:07:31

12102 - SPRD SPECTRUM ON & RANGING SPC			
MDM	DSM	TITLE	TIMEWORD
1	4738	SPD SPM ON	000:00:18:00
2	4738	SPD SPM ON	000:00:18:00
1	4745	RANGING OFF	000:00:01:00
2	4745	RANGING OFF	000:00:01:00
1	4746	RANGING ON	000:00:02:30
2	4746	RANGING ON	000:00:02:30
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

12103 - RTLS SPC			
MDM	DSM	TITLE	TIMEWORD
1	4735	STDN LO MODE	000:00:14:00
2	4735	STDN LO MODE	000:00:14:00

12104 - SGLS @ 10:30M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4473	SGLS SALVO (NHS)	000:00:10:30
2	4473	SGLS SALVO (NHS)	000:00:10:30
1	4738	SPD SPM ON	000:00:18:00
2	4738	SPD SPM ON	000:00:18:00

12105 - TDRS @ 12:20M SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:12:20
2	4470	TDRS SBD SALVO	000:00:12:20
1	4759	NSP UL HDR	000:00:12:21
2	4759	NSP UL HDR	000:00:12:21
1	4764	NSP DL HDR	000:00:12:21
2	4764	NSP DL HDR	000:00:12:21
1	4766	XPNDR UL FLTR WD	000:00:12:21
2	4766	XPNDR UL FLTR WD	000:00:12:21
1	4739	SPD SPM OFF	000:00:12:21
2	4739	SPD SPM OFF	000:00:12:21

12106 - TDRS DOWN SPC - PF1			
MDM	DSM	TITLE	TIMEWORD
1	4473	SGLS SALVO (OTS)	000:00:17:45
1	4470	TDRS SBD SALVO	000:00:25:00
1	4759	NSP UL HDR	000:00:25:01
1	4764	NSP DL HDR	000:00:25:01
1	4766	XPNDR UL FLTR WD	000:00:25:01
1	4473	SGLS SALVO (DGS)	000:00:38:30
1	4470	TDRS SBD SALVO	000:00:48:00
1	4759	NSP UL HDR	000:00:48:01
1	4764	NSP DL HDR	000:00:48:01
1	4766	XPNDR UL FLTR WD	000:00:48:01

12107 - TDRS DOWN SPC - PF2			
MDM	DSM	TITLE	TIMEWORD
2	4473	SGLS SALVO (OTS)	000:00:17:45
2	4470	TDRS SBD SALVO	000:00:25:00
2	4759	NSP UL HDR	000:00:25:01
2	4764	NSP DL HDR	000:00:25:01
2	4766	XPNDR UL FLTR WD	000:00:25:01
2	4473	SGLS SALVO (DGS)	000:00:38:30
2	4470	TDRS SBD SALVO	000:00:48:00
2	4759	NSP UL HDR	000:00:48:01
2	4764	NSP DL HDR	000:00:48:01
2	4766	XPNDR UL FLTR WD	000:00:48:01

12108 - TDRS AT TCS LOS SPC			
MDM	DSM	TITLE	TIMEWORD
1	4470	TDRS SBD SALVO	000:00:25:00
2	4470	TDRS SBD SALVO	000:00:25:00
1	4759	NSP UL HDR	000:00:25:01
2	4759	NSP UL HDR	000:00:25:01
1	4764	NSP DL HDR	000:00:25:01
2	4764	NSP DL HDR	000:00:25:01
1	4766	XPNDR UL FLTR WD	000:00:25:01
2	4766	XPNDR UL FLTR WD	000:00:25:01
-	-	-	-
-	-	-	-

These SPCs are prestored in the standard rfae\_57 directory and are built with reference to PET 1. PET 1 in the CMD server should be set to the expected lift-off time. Then these SPCs should be submitted to the CMD server. If the launch slips by more than a few seconds, the PET 1 in the CMD server should be updated and all the SPCs should be resubmitted/overwritten to adjust for the new liftoff time. Always verify the time-word associated with any SPC prior to uplinking it to the vehicle. The SPCs are sent to both P/L MDMs for redundancy, except for 12106, 12107. 12106 and 12107 are sent to single P/L MDMs because of the 25 command restriction in the onboard SPC buffer. The nominal SPCs (12101 and 12102) are uplinked at about T - 8M, unless there is an expected hold at T - 5M. 12102 is the nominal SPC to turn spread spectrum back on and optimize ranging during ascent.

12103 through 12108 are contingency SPCs. 12103 is used for an RTLS case (note that uplink coding stays ON). 12104, 12105, and 12106 are used for a TDRS down case. 12107 is used for a TDRS down case combined with a P/L MDM 1 problem. 12108 is used if the crew does a PNL/CMD or SGLS item entry at TCS.

57° contingency SPC procedures are as follows:

**RTLS**

CLEAR nominal SPCs (12101/2) and uplink 12103.

**TDRS down**

CLEAR nominal SPCs (12101/2), uplink 12104, 12105, and 12106 (if PF1 is not available, uplink 12107 instead of 12106). Have command manage forward link, as required (WLPS and NHSS).

*REMEMBER TO GCMR NETWORK FOR SS ON DURING TCS IF REQD.*

**East Coast Abort Landing (ECAL)**

Monitor GSTDN antenna elevation and if it drops to 5° prior to 7M, consider commanding to TDRS early via MRTC.

**PNL/CMD or SGLS item entry at TCS**

Uplink 12108 prior to TCS LOS.

*REMEMBER TO GCMR NETWORK FOR SS ON DURING TCS IF REQD.*

4. 57° standard MRTCs: same as 51° inclination procedures. (See Section E of this SCP.)
5. 57° East Coast Abort Landing

Same as 51° inclination procedures, with the addition of the following three sites. (See Section E of this SCP.)

- a. Myrtle Beach, South Carolina (MYR)
- b. Dover, Delaware (DOV)
- c. Goose Bay, Newfoundland/Canada (YYR)

H. 57° INCLINATION ENTRY PROCEDURES

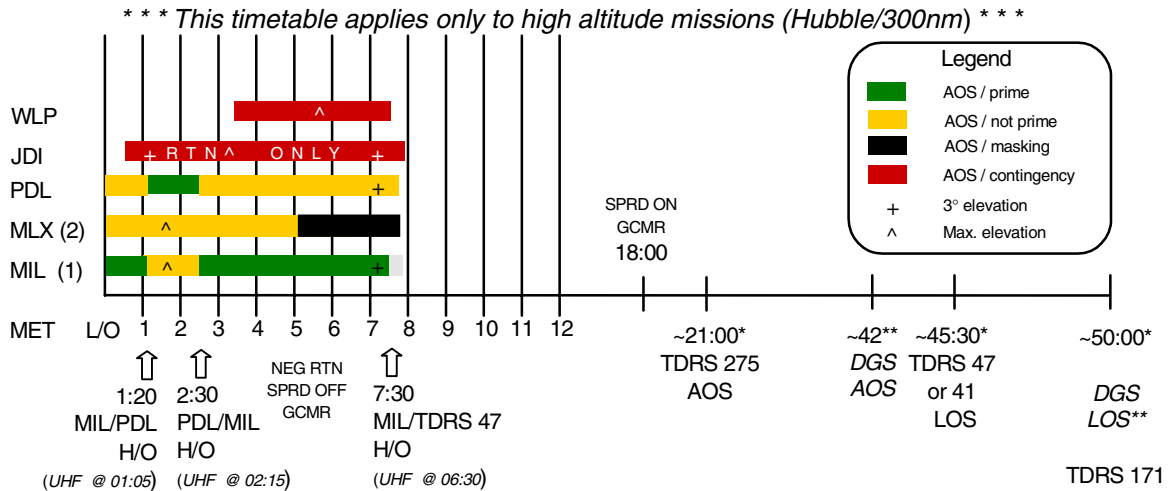
Same as 51° inclination procedures. (See Section F of this SCP.)

I. INCO A/E CUE CARDS

The remaining several pages are quick reference cue cards. The console books receive actual color versions of these cue cards, which are laminated for extra protection. The color is desired to add extra clarity to the information being presented because of the critical nature of the flight phase.

These cue cards are a compilation of the information contained in SCPs 3.2, 3.3, 3.4, 3.5, and 3.103 in a "quick reference" format that is designed for on console/real-time use. The specific inclination page and the malfunction action page are intended to be removed from the book and used by the operator on console.

### 28° INCLINATION ASCENTS



\*These times are dependent on ascent performance and altitude. These times should be compared to ACQMON periodically post-MECO.  
\*\*DGS will be available only for high altitude missions at this inclination.

TMBUs	
PRE	12404 -PDL
2:17	12401 -MIL (nominal)
	12405 -JDI

SPCs	
12101	TDRS @ 7:30m
12102	SS ON @ 18m + RNG
12103	RTLS - 14m (up coding ON)
12104	TDRS at 8m

MRTCs	
1510	TDRS SS OFF
1512	TDRS URF SS OFF
4769	TDRS SS ON
1514	TDRS URF SS ON
1514	TDRS URF SS ON

ANTS TO GROUND STATION	
KSC15	URF
KSC33	ULA
EDW04	ULA
EDW22	URA

Roll to Heads Up	Nominal, ATO, Late TAL	Early TAL
	V-REL = 12.2k	V-REL = 14.0k

Aborts *	OPS 1	OPS 6
3 eng out	TAL - TAL else - ditch	All - ditch
2 eng out	1st stg - ditch 2nd stg - BDA / ditch droop - TAL / ELS / ditch	Red / RTLS - RTLS else - ditch
Stuck (1 eng out + 1 eng stuck min)	1st stg - ditch RTLS - RTLS droop - TAL / ELS / ditch TAL - TAL	

\*From STS-109 ASC C/L.

BFS SPEC 51 OVERRIDE	
ITEM 46	TDRS (OPS 1/6 SS OFF)
ITEM 47	STDN HI (OPS 1/6 UL coding ON)
ITEM 48	STDN LO (OPS 1/6 UL coding ON)
ITEM 49	SGLS

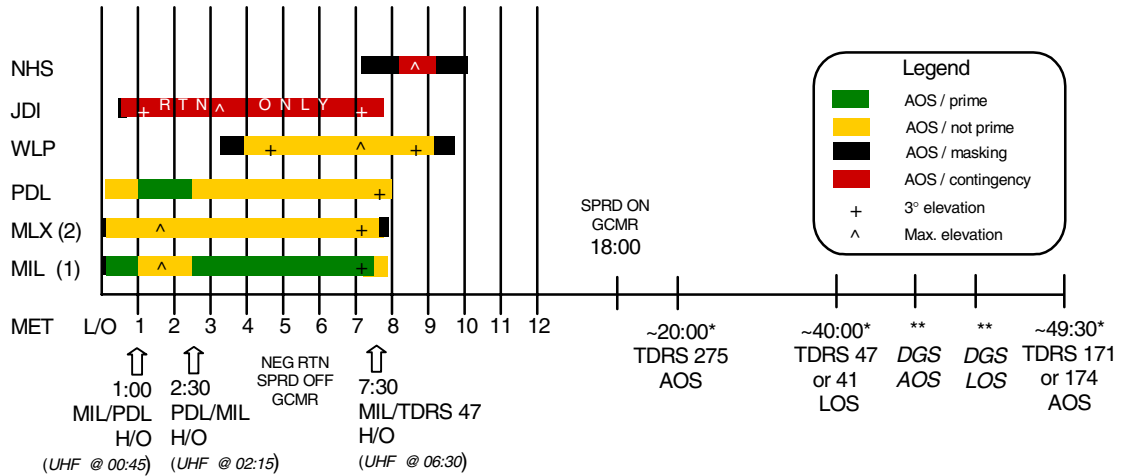
LCC			
CT-02	XPNDR AGC	T-9	2 of 2 rqd (NSP FRM & voice test)
CT-03	GCIL ACTIVE	T-31	1 of 2 pwr/decoders rqd (cmd test)
CT-04	NSP FRM SYNC	T-31	2 of 2 rqd (if COMSEC, byp & blk)
CT-05	VOICE	T-5	1 of 2 A/G + UHF rqd (voice test)
CT-09	PA RF OUT	T-9	2 of 2 rqd (use ground station)
INS-01	OI PCMMU	T-31	2 of 2 rqd (BSR evaluation)
INS-02	OPS RCDR	T-5	1 of 2 'OI' rqd (BITE/temp/motion)
INS-02a	SSR ANOMALY	T-5	1 of 2 rqd (critical BITE)
INS-04	OI DSC BITE	T-9	data rqd (parameter evals)
INS-05	OI MDM WRAP	T-31	data rqd (PCM swap, pwr cycle)

**28° INCLINATION ASCENTS**

Site	Rwy	TDRS W W174 (F-5) antenna	TDRS W171 (F-7) antenna	TDRS W47 (F-6) antenna	TDRS E W41 (F-4) antenna	TDRS Z W275 (F-3) antenna
Amilcar, Cabral	2 20	No view No view	No view No view	TBD	URA URF	TBD
Banjul, Gambia	14 32	No view No view	No view No view	TBD	URA ULF	TBD
Ben Guerir, Morocco	18 36	No view No view	No view No view	TBD	URF ULA	TBD
Bermuda	12 30	No view No view	No view No view	TBD	ULF ULA	TBD
Edwards, California	4 22	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF	TBD	ULF ULA	TBD
	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	15 33	URA ULF	URA ULF	TBD	ULF ULA	TBD
	18 36	URF ULA	URF ULA	TBD	ULF ULA	TBD
KSC, Florida	15 33	No view No view	No view No view	TBD	ULF ULA	TBD
Las Palmas, Spain	3 21	No view No view	No view No view	TBD	URA URF	TBD
Moron, Spain	2 20	No view No view	No view No view	TBD	URA URF	TBD
Northrup, New Mexico	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF		ULF ULA	
Rota, Spain	28 10	No view No view	No view No view	TBD	ULF URA	TBD
Zaragosa, Spain	12 30	No view No view	No view No view	TBD	URA ULF	TBD



### 39° INCLINATION ASCENTS



\*These times are dependent on ascent performance and altitude.  
These times should be compared to ACQMON periodically post-MECO.  
\*\*DGS will be available only for high altitude missions at this inclination.

TMBUs	
PRE	12404 -PDL
2:17	12401 -MIL (nominal)
	12402 -WLP
	12405 -JDI

SPCs	
12101	TDRS @ 7:30m
12102	SS ON @ 18m + RNG
12103	RTLS - 14m (up coding ON)
12104	TDRS at 9m

MRTCs	
1510	TDRS SS OFF
1512	TDRS URF SS OFF
4769	TDRS SS ON
1514	TDRS URF SS ON

ANTS TO GROUND STATION	
KSC15	URF
KSC33	ULA
EDW04	ULA
EDW22	URA

Roll to Heads Up	Nominal, ATO, Late TAL	Early TAL
	V-REL = 12.2k	V-REL = 14.0k

Aborts *	OPS 1	OPS 6
3 eng out	TAL - TAL else - ditch	All - ditch
2 eng out	1st stg - ditch 2nd stg - BDA / ditch droop - TAL / ELS / ditch	Red / RTLS - RTLS else - ditch
Stuck (1 eng out + 1 eng stuck min)	1st stg - ditch RTLS - RTLS droop - TAL / ELS / ditch TAL - TAL	

\*From STS-107 ASC C/L.

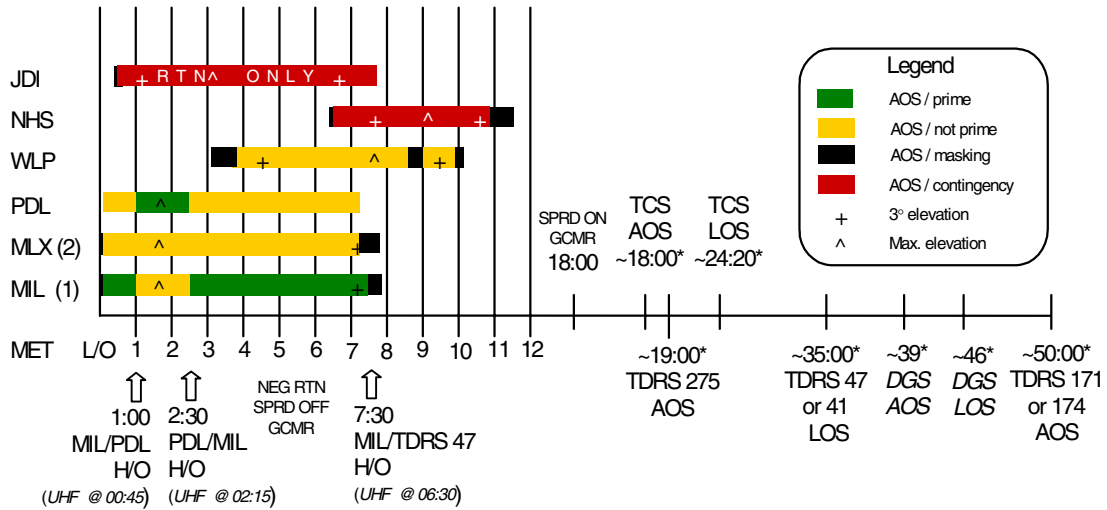
BFS SPEC 51 OVERRIDE	
ITEM 46	TDRS (OPS 1/6 SS OFF)
ITEM 47	STDN HI (OPS 1/6 UL coding ON)
ITEM 48	STDN LO (OPS 1/6 UL coding ON)
ITEM 49	SGLS

LCC			
CT-02	XPNDR AGC	T-9	2 of 2 rqd (NSP FRM & voice test)
CT-03	GCIL ACTIVE	T-31	1 of 2 pwr/decoders rqd (cmd test)
CT-04	NSP FRM SYNC	T-31	2 of 2 rqd (if COMSEC, byp & blk)
CT-05	VOICE	T-5	1 of 2 A/G + UHF rqd (voice test)
CT-09	PA RF OUT	T-9	2 of 2 rqd (use ground station)
INS-01	OI PCMMU	T-31	2 of 2 rqd (BSR evaluation)
INS-02	OPS RCDR	T-5	1 of 2 'OI' rqd (BITE/temp/motion)
INS-02a	SSR ANOMALY	T-5	1 of 2 rqd (critical BITE)
INS-04	OI DSC BITE	T-9	data rqd (parameter evals)
INS-05	OI MDM WRAP	T-31	data rqd (PCM swap, pwr cycle)

**39° INCLINATION ASCENTS**

Site	Rwy	TDRS W W174 (F-5) antenna	TDRS W171 (F-7) antenna	TDRS W47 (F-6) antenna	TDRS E W41 (F-4) antenna	TDRS Z W275 (F-3) antenna
Amilcar, Cabral	2 20	No view No view	No view No view	TBD	URA URF	TBD
Banjul, Gambia	14 32	No view No view	No view No view	TBD	URA ULF	TBD
Ben Guerir, Morocco	18 36	No view No view	No view No view	TBD	URF ULA	TBD
Bermuda	12 30	No view No view	No view No view	TBD	ULF ULA	TBD
Edwards, California	4 22	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF	TBD	ULF ULA	TBD
	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	15 33	URA ULF	URA ULF	TBD	ULF ULA	TBD
	18 36	URF ULA	URF ULA	TBD	ULF ULA	TBD
KSC, Florida	15 33	No view No view	No view No view	TBD	ULF ULA	TBD
Las Palmas, Spain	3 21	No view No view	No view No view	TBD	URA URF	TBD
Moron, Spain	2 20	No view No view	No view No view	TBD	URA URF	TBD
Northrup, New Mexico	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF		ULF ULA	
Rota, Spain	28 10	No view No view	No view No view	TBD	ULF URA	TBD
Zaragosa, Spain	12 30	No view No view	No view No view	TBD	URA ULF	TBD

51° INCLINATION ASCENTS



\*These times are dependent on ascent performance and altitude. These times should be compared to ACQMON periodically post-MECO.

TMBUs	
PRE	12404 - PDL
2:17	12401 -MIL (nominal)
	12402 - WLP
	12403 - NHS
	12405 - JDI

SPCs	
12101	TDRS @ 7:30m
12102	SS ON @ 18m + RNG
12103	RTLS - 14m (up coding ON)
12104	SGLS @ 10m + SS ON
12105	TDRS @ 11:25m
12106	TDRS U - PF1
12107	TDRS U - PF2
12108	TDRS @ TCS los

MRTCes	
1510	TDRS ss off
1511	TDRS URA ss off (not TAL)
1512	TDRS URF ss off (TAL)
4769	TDRS ss on
1513	TDRS URA ss on (not TAL)
1514	TDRS URF ss on (TAL)

ANTS TO GROUND STATIONS	
KSC 15	URF
KSC 33	ULA
EDW 04	ULA
EDW 22	URA

Roll to Heads Up	Nominal, ATO, Late TAL	Early TAL
	V-REL = 12.2k	V-REL = 14.0k

Aborts*	OPS 1	OPS 6
3 eng out	TAL - TAL else - ECAL / ditch	All - ditch
2 eng out	1st stg - ditch 2nd stg - ECAL / ditch droop - TAL / ELS / ditch	Red / RTLS - RTLS else - ditch
Stuck (1 eng out + 1 eng stuck min)	1st stg - ditch RTLS - RTLS droop - TAL / ELS / ditch TAL - TAL	

\*From STS-108 ASC C/L.

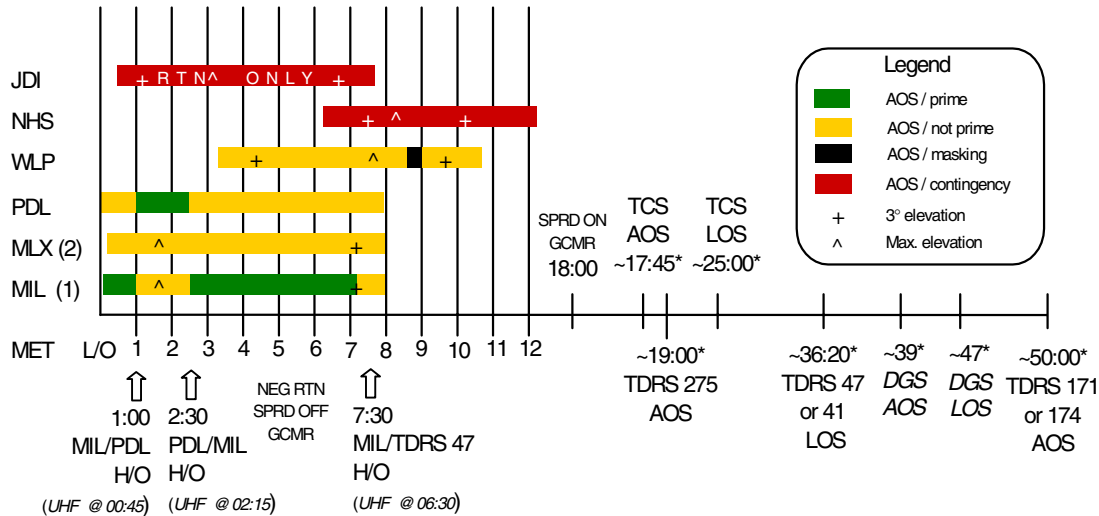
BFS SPEC 51 OVERRIDE	
ITEM 46	TDRS (OPS 1/6 SS OFF)
ITEM 47	STDN HI (OPS 1/6 UL coding ON)
ITEM 48	STDN LO (OPS 1/6 UL coding ON)
ITEM 49	SGLS

LCC			
CT-02	XPNDR AGC	T-9	2 of 2 rqd (NSP FRM & voice test)
CT-03	GCIL ACTIVE	T-31	1 of 2 pwr/decoders rqd (cmd test)
CT-04	NSP FRM SYNC	T-31	2 of 2 rqd (if COMSEC, byp & blk)
CT-05	VOICE	T-5	1 of 2 A/G + UHF rqd (voice test)
CT-09	PA RF OUT	T-9	2 of 2 rqd (use ground station)
INS-01	OI PCMMU	T-31	2 of 2 rqd (BSR evaluation)
INS-02	OPS RCDR	T-5	1 of 2 'OI' rqd (BITE/temp/motion)
INS-02a	SSR ANOMALY	T-5	1 of 2 rqd (critical BITE)
INS-04	OI DSC BITE	T-9	data rqd (parameter evals)
INS-05	OI MDM WRAP	T-31	data rqd (PCM swap, pwr cycle)

**51° INCLINATION ASCENTS**

Site	Rwy	TDRS W W174 (F-5) antenna	TDRS W171 (F-7) antenna	TDRS W47 (F-6) antenna	TDRS E W41 (F-4) antenna	TDRS Z W275 (F-3) antenna
Amilcar, Cabral	2 20	No view No view	No view No view	TBD	URA URF	TBD
Banjul, Gambia	14 32	No view No view	No view No view	TBD	URA ULF	TBD
Ben Guerir, Morocco	18 36	No view No view	No view No view	TBD	URF ULA	TBD
Cherry Point, North Carolina	32 23	No view No view	No view No view	TBD	ULA ULA	TBD
Edwards, California	4 22	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF	TBD	ULF ULA	TBD
	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	15 33	URA ULF	URA ULF	TBD	ULF ULA	TBD
	18 36	URF ULA	URF ULA	TBD	ULF ULA	TBD
	15 33	No view No view	No view No view	TBD	ULF ULA	TBD
Las Palmas, Spain	3 21	No view No view	No view No view	TBD	URA URF	TBD
Moron, Spain	2 20	No view No view	No view No view	TBD	URA URF	TBD
Northrup, New Mexico	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF	TBD	ULF ULA	TBD
	5 23	No view No view	No view No view	TBD	URF ULA	TBD
	14 32	No view No view	No view No view	TBD	ULF ULA	TBD
Pease, New Hampshire	16 34	No view No view	No view No view	TBD	ULF ULA	TBD
Rota, Spain	28 10	No view No view	No view No view	TBD	ULF URA	TBD
Zaragosa, Spain	12 30	No view No view	No view No view	TBD	URA ULF	TBD

57° INCLINATION ASCENTS



\*These times are dependent on ascent performance and altitude.  
These times should be compared to ACQMON periodically post-MECCO.

TMBUs	
PRE	12404 - PDL
2:17	12401 -MIL (nominal)
	12402 - WLP
	12403 - NHS
	12405 - JDI

SPCs	
12101	TDRS @ 7:30m
12102	SS ON @ 18m + RNG
12103	RTLS - 14m (up coding ON)
12104	SGLS @ 10m + SS ON
12105	TDRS @ 11:25m
12106	TDRS Ⓚ - PF1
12107	TDRS Ⓚ - PF2
12108	TDRS @ TCS los

MRTC's	
1510	TDRS ss off
1511	TDRS URA ss off (not TAL)
1512	TDRS URF ss off (TAL)
4769	TDRS ss on
1513	TDRS URA ss on (not TAL)
1514	TDRS URF ss on (TAL)

ANTS TO GROUND STATIONS	
KSC 15	URF
KSC 33	ULA
EDW 04	ULA
EDW 22	URA

Roll to Heads Up	Nominal, ATO, Late TAL	Early TAL
	V-REL = 12.2k	V-REL = 14.0k

Aborts*	OPS 1	OPS 6
3 eng out	TAL - TAL else - ECAL / ditch	All - ditch
2 eng out	1st stg - ditch 2nd stg - ECAL / ditch droop - TAL / ELS / ditch	Red / RTLS - RTLS else - ditch
Stuck (1 eng out + 1 eng stuck min)	1st stg - ditch RTLS - RTLS droop - TAL / ELS / ditch TAL - TAL	

\*From STS-TBD ASC C/L.

BFS SPEC 51 OVERRIDE	
ITEM 46	TDRS (OPS 1/6 SS OFF)
ITEM 47	STDN HI (OPS 1/6 UL coding ON)
ITEM 48	STDN LO (OPS 1/6 UL coding ON)
ITEM 49	SGLS

LCC			
CT-02	XPNDR AGC	T-9	2 of 2 rqd (NSP FRM & voice test)
CT-03	GCIL ACTIVE	T-31	1 of 2 pwr/decoders rqd (cmd test)
CT-04	NSP FRM SYNC	T-31	2 of 2 rqd (if COMSEC, byp & blk)
CT-05	VOICE	T-5	1 of 2 A/G + UHF rqd (voice test)
CT-09	PA RF OUT	T-9	2 of 2 rqd (use ground station)
INS-01	OI PCMMU	T-31	2 of 2 rqd (BSR evaluation)
INS-02	OPS RCDR	T-5	1 of 2 'OI' rqd (BITE/temp/motion)
INS-02a	SSR ANOMALY	T-5	1 of 2 rqd (critical BITE)
INS-04	OI DSC BITE	T-9	data rqd (parameter evals)
INS-05	OI MDM WRAP	T-31	data rqd (PCM swap, pwr cycle)

**57° INCLINATION ASCENTS**

Site	Rwy	TDRS W W174 (F-5) antenna	TDRS W171 (F-7) antenna	TDRS W47 (F-6) antenna	TDRS E W41 (F-4) antenna	TDRS Z W275 (F-3) antenna
Amilcar, Cabral	2 20	No view No view	No view No view	TBD	URA URF	TBD
Banjul, Gambia	14 32	No view No view	No view No view	TBD	URA ULF	TBD
Ben Guerir, Morocco	18 36	No view No view	No view No view	TBD	URF ULA	TBD
Cherry Point, North Carolina	32 23	No view No view	No view No view	TBD	ULA ULA	TBD
Edwards, California	4 22	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF	TBD	ULF ULA	TBD
	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	15 33	URA ULF	URA ULF	TBD	ULF ULA	TBD
	18 36	URF ULA	URF ULA	TBD	ULF ULA	TBD
KSC, Florida	15 33	No view No view	No view No view	TBD	ULF ULA	TBD
Las Palmas, Spain	3 21	No view No view	No view No view	TBD	URA URF	TBD
Moron, Spain	2 20	No view No view	No view No view	TBD	URA URF	TBD
Northrup, New Mexico	5 23	URA URF	URA URF	TBD	URF ULA	TBD
	17 35	URA ULF	URA ULF		ULF ULA	
Oceana, Virginia	5 23	No view No view	No view No view	TBD	URF ULA	TBD
Otis, Massachusetts	14 32	No view No view	No view No view	TBD	ULF ULA	TBD
Pease, New Hampshire	16 34	No view No view	No view No view	TBD	ULF ULA	TBD
Rota, Spain	28 10	No view No view	No view No view	TBD	ULF URA	TBD
Zaragosa, Spain	12 30	No view No view	No view No view	TBD	URA ULF	TBD

## ASCENT MALFUNCTION PROCEDURES (before TDRS handover, unless specified)

RED = INCO systems notes  
GREEN = uplink actions  
BLUE = crew actions

<b>S</b>	SHARP CUTOFF	PA   XPNDR(acq)   PNL,CMD   Best Ant
	STATIC FRAME	if no <b>CMD STR 1</b> ⇨ PCMMU   NSP else ⇨ NSP   PCMMU
<b>B</b>	CARRIER NO MOD	if no <b>CMD STR 1</b> ⇨ XPNDR   NSP   PNL,CMD else ⇨ NSP   XPNDR(acq)   PNL,CMD
<b>A</b>	NO NSP BIT/FRAME (No CMD or S-voice)	PNL,CMD before SPC timeout (UHF only) else ⇨ crew setup PNL A1 then PNL,CMD
<b>N</b>	COMSEC 2 RCV FAIL (No CMD or S-voice)	if no <b>CMD STR 1</b> ⇨ try Encryption Select - Bypass (PNL A1L) else ⇨ PNL,CMD before SPC timeout (UHF only) else ⇨ crew setup PNL A1 then PNL,CMD
<b>D</b>	FF1 DOWN (No CMD on NSP 1)	No action (remember no CMD if PNL,CMD)
	FF3 DOWN (No CMD on NSP 2)	if CMD Required ⇨ PNL,CMD
	GPC 3 DOWN (No CMD on NSP 2)	if CMD Required ⇨ PNL,CMD else ⇨ wait for restrng post MECO
	BFS DROPS TRK ON STRING 3 (SPC OK, No BFS CMD)	if BFS CMD Required ⇨ PNL,CMD Sites to expect nonoptimal antennas (cannot send AM loads)
<b>D</b>	BFS STANDALONE (trk no strings) (SPC OK, No BFS CMD)	Monitor ant selects & S/S Crew sel best ant (BFS NAV bad / SPC OK)
	BFS DOWN (fail/fail to halt) (No SPC, No BFS CMD)	CMD antennas via GNC CMD TDRS+ANT via MRTCC if rqd, Crew select best antenna on TDRS TDRE NOM=URF/URA   TAL=URF
<b>P</b>	BFS TRANSIENT HALT (SPC LOST)	Reuplink SPC or command manually (note BFS IN OPS 0 steps)
<b>S</b>	BFS IN OPS 0 (SPC OK, No AM)	Command antennas via BFS TDRE NOM=URF/URA   TAL=URF
	NO GNC DOWNLIST	DPS Change downlisters   Alt PCMMU (fxd fmt)
	NO BFS DOWNLIST	if <b>FLT wants it</b> ⇨ Alt PCMMU (fxd fmt)
	PF1 DOWN (ANT 1, OPS 1, PLR, OEX)	Sel MDM 2 on CMD Panel if MADS tape critical ⇨ MSTR MADS - OFF (PNL C3)
	PF2 DOWN (ANT 2, OPS 2)	✓ MDM 1 on CMD Panel Sel ANT ELEC #1 CREW dump OPS 2 on orbit if rqd
	NO A/G 1 D/L (mult crew)	if STDN, no action if TDRS and NSP BITE ⇨ Alt NSP if TDRS and no NSP BITE ⇨ Alt ACCU   Alt NSP
<b>A</b>	NO UHF D/L CARRIER (mult crew)	Alt Freq (✓site)   PA Off (✓ squelch off @ site)   Guard (✓ site)
<b>U</b>	NO UHF D/L MOD (carrier no mod) (mult crew)	Alt ACCU   Alt Freq (✓site)
<b>D</b>	NO UHF U/L S/S	UHF only call   Alt Freq (✓site)   Guard (✓site)
<b>I</b>	NO UHF U/L (good S/S)	Alt ACCU   Alt Freq (✓site)
	STUCK MIKE	Crewman cycle PTT several times ATU BU   if nojoy (stuck button) ⇨ ATU Norm + RCV ONLY or MIC Off if BU OK & UHF carrier still ON (stuck ATU) ⇨ RCV on A/A
<b>O</b>	PTT LOST (RHC and HIU)	BU on ATU   NORM on ATU + VOX/VOX
<b>I</b>	MDM OF3 DOWN	Crew select antennas manually for TDRS TDRE NOM=URF/URA   TAL=URF
<b>N</b>	OPS RCDR TEMP >120°	Stop RCDR, if OPS 2 reconfig OPS 1
<b>S</b>	NO FM D/L (carrier no mod or sharp cutoff)	Alt FM System   ✓Hemi sel
<b>T</b>	NO MTU IRIG B (No COMSEC T/A)	if CMD rqd ⇨ Encryption Select - Bypass (PNL A1L)

## ENTRY MALFUNCTION PROCEDURES (after STDN handover, unless specified)

RED = INCO systems notes  
GREEN = uplink actions  
BLUE = crew actions

<b>S</b>	SHARP CUTOFF	<b>if TDRS</b> ⇨ PA   XPNDR(acq)   PNL,CMD <b>if STDN</b> ⇨ STDN LO   XPNDR(acq)   PNL,CMD   Best Ant
	STATIC FRAME	<b>if no CMD STR 1</b> ⇨ PCMMU   NSP else ⇨ NSP   PCMMU
<b>B</b>	CARRIER NO MOD	<b>if no CMD STR 1</b> ⇨ XPNDR   NSP   PNL,CMD else ⇨ NSP   XPNDR(acq)   PNL,CMD
<b>A</b>	NO NSP BIT/FRA (No CMD or S-voice)	<b>if TDRS</b> ⇨ crew may setup PNL A1 then PNL,CMD <b>if STDN</b> ⇨ PNL,CMD if CMD or S-voice rqd (UHF only)
<b>D</b>	COMSEC 2 RCV FAIL (No CMD or S-voice)	<b>if no CMD STR 1</b> ⇨ try Encryption Select - Bypass (PNL A1L) else <b>if TDRS</b> ⇨ crew may setup PNL A1 then PNL,CMD else <b>if STDN</b> ⇨ PNL,CMD if CMD rqd (UHF only)
	FF1 DOWN (No CMD on NSP 1)	No action (remember no CMD if PNL,CMD)
	FF3 DOWN (No CMD on NSP 2)	if CMD Required ⇨ PNL,CMD
	GPC 3 DOWN (No CMD on NSP 2)	if CMD Required ⇨ PNL,CMD
	BFS DROPS TRK ON STRING 3 (SPC OK, No BFS CMD)	if BFS CMD Required ⇨ PNL,CMD
<b>D</b>	BFS STANDALONE (trk no strings) (SPC OK, No BFS CMD)	Monitor ant selects & S/S Crew sel best ant if rqd (BFS NAV bad / SPC OK)
<b>P</b>	BFS DOWN (fail/fail to halt) (No SPC, No BFS CMD)	CMD antennas via GNC CMD to STDN via SALVO
	BFS TRANSIENT HALT (SPC LOST)	<b>if TDRS</b> ⇨ Reuplink SPC or command manually (note BFS IN OPS 0 steps)
<b>S</b>	BFS IN OPS 0 (SPC OK, No AM)	Command antennas via BFS
	NO GNC DOWNLIST	DPS Change downlisters   Alt PCMMU (fxd fmt)
	NO BFS DOWNLIST	<b>if FLT wants it</b> ⇨ Alt PCMMU (fxd fmt)
	PF1 DOWN (ANT 1, OPS 1, PLR, OEX)	Sel MDM 2 on CMD Panel if rqd ⇨ crew perform postlanding MADS CAL
	PF2 DOWN (ANT 2, OPS 2)	✓ MDM 1 on CMD Panel Sel ANT ELEC #1
	NO A/G 1 D/L (mult crew)	if TDRS and NSP BITE ⇨ Alt NSP if TDRS and no NSP BITE ⇨ Alt ACCU   Alt NSP if STDN, no action
<b>A</b>	NO UHF D/L CARRIER (mult crew)	Alt Freq (✓site)   PA Off (✓ squelch off @ site)   Guard (✓ site)
<b>U</b>	NO UHF D/L MOD (carrier no mod) (mult crew)	Alt ACCU   Alt Freq (✓site)
<b>D</b>	NO UHF U/L S/S	UHF only call   Alt Freq (✓site)   Guard (✓site)
<b>I</b>	NO UHF U/L (good S/S)	Alt ACCU   Alt Freq (✓site)
<b>I</b>	STUCK MIKE	Crewman cycle PTT several times ATU BU   if nojoy (stuck button) ⇨ ATU Norm + RCV ONLY or MIC Off if BU OK & UHF carrier still ON (stuck ATU) ⇨ RCV on A/A
<b>O</b>	PTT LOST (RHC and HIU)	BU on ATU   NORM on ATU + VOX/VOX
<b>I</b>	MDM OF3 DOWN	<b>if TDRS</b> ⇨ Crew select antennas manually for STDN or BFS ANT PTG INH and CMD antennas via BFS
<b>N</b>	OPS RCDR TEMP >120°	Stop RCDR
<b>S</b>	NO FM D/L (no carrier/sharp cutoff)	Alt FM System   ✓Hemi sel
<b>T</b>	NO MTU IRIG B (No COMSEC T/A)	if CMD rqd ⇨ Encryption Select - Bypass (PNL A1L)



**TITLE**

ON-ORBIT TDRSS/GROUND OPERATION PROCEDURES

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

To describe the general procedures necessary for controlling TDRS operations.

The command restrictions/constraints are shown in Figure 3.6-1.

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**COMMAND RESTRICTIONS/CONSTRAINT**

1. Hazard/safety implication (should/are safed?): None
2. Valid software major modes (if applicable, include OPS Mode: 01, X02....):

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC										
SM			X		X					
BFS		X		X			X			
PL										
OPS 0										

3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: None

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**Figure 3.6-1. Command restrictions/constraints**

**GENERAL**

COMMAND will be the single point of contact for permission scheduling and real-time TDRS space network (SN) configurations/reconfigurations.

Forward link bit rates and modulation output provided by the uplink front-end processor (FEP) are controlled in the Mission Control Center (MCC) at the COMMAND workstation. The ground control message request (GCMR) capability, which is used to request SN configuration changes, is also located at the COMMAND workstation in the operations support team (OST) Ground Operations Support Room (GOSR). GCMR response times are specified to be 15 seconds (S-band) and 20 seconds (Ku-band). A new GCMR should not be sent before the previous GCMR to the same service has been

processed, or it will be rejected. Depending upon the GCMR, the forward or return link will be interrupted during the applicable GCMR activity. Verbal GCMR activity, used in the event that the electronic interface is unavailable, is coordinated by COMMAND with the Goddard Space Flight Center (GSFC) Network Control Center (NCC) or White Sands Complex (WSC), when required. Verbal GCMR's can take up to 10 minutes to accomplish, depending upon activities encompassing simple prenotification to emergency situations. The NCC validates GCMR's and forwards them to WSC as a GCM for implementation.

Both S-band and Ku-band will acquire with modulation **ON if the forward link is selected to high data rate**. If low data rate is selected, acquisition must be performed with modulation OFF to preclude false locks. Since the WSC software has been modified to allow valid Doppler tracking data to be processed with Doppler compensation always enabled, the forward link frequency will always be adjusted for the orbiter center frequency (no static phase error buildup). Ku-band has always been used with Doppler compensation enabled, since there is no Ku-band Doppler tracking (noncoherent link).

TDRS West acquisitions will occur automatically when the orbiter comes into view of the satellite, which is approximately the TDRS SHO event start time. Normal TDRS West handover to TDRS East will occur automatically at TDRS West loss of signal (LOS). An "early handover" to TDRS East occurs at TDRS East AOS. A "midpass" handover occurs after TDRS East AOS but before TDRS West LOS. S-band and Ku-band services are scheduled to start at the same time (in most cases but this is not mandatory), then both S- and Ku-band forward links will begin to radiate at the scheduled SHO event start time. A minimum of 16 seconds is required between West and East SHO times, but usually 20 seconds is used for simplification. When acquisition times are added, this implies that about 30-45 seconds of data loss is expected during a TDRS handover.

The White Sands Complex is capable of acquiring both S-band coherent and noncoherent return links without any intervention.

The WSC equipment will nominally be configured for the "Ku-band program track" mode. This mode has demonstrated acquisition performance superior to the alternate "autotrack" mode. WSC will acquire the return link S-band carrier and attempt bit sync. Both the Ku-band return link carrier and subcarrier will be acquired, and bit sync will be accomplished on all digital channels. Analog data is demodulated from the subcarrier and processed separately.

As long as there is no bandwidth conflict with other TDRSS users, the statistical multiplexer (Ku-band channel-3 STAT MUX) does not require reconfiguration for bit rate changes (the STAT MUX allocates bandwidth automatically). However, a Ku-band return (KRTN) GCMR is still required to reconfigure WSC bit syncs.

TDRSS status data in the form of operational data messages (ODM's) and Data Quality Measurements (DQM's), which are statistical frame sync data, are available on the Telcom SN Status display. The NCC management of the SN includes generating and distributing schedules, resolving conflicts, preparing configuration control messages upon GCMR request, monitoring equipment status and configuration using ODM's, monitoring performance using DQM's, and performing fault isolation. The NCC does not generally process user telemetry and command data; however, it does receive calibrated ancillary data from JSC, which is used to monitor orbiter communications systems status. The MCC supplies orbiter data to the NCC for monitoring antenna pointing and some communications status on a specially built display.

The MCC requires NCC support for scheduling of all services offered by the SN in support of shuttle missions. This includes S-band single access (SSA) forward and return services, Ku-band single access (KSA) forward and return services, tracking services, and simulation services for the above. The MCC coordinates real-time changes to forward and return link services with WSC personnel.

The SN is supported by the NASA communication (NASCOM) data transport system (DTS). This support is provided through the NASCOM-sponsored Internet Protocol (IP) network.

The SN DTS consists of two distinct major multichannel transport systems. The characteristics of each are unique to the contracted TDRSS forward and return service interfaces it supports. Type 1 interfaces (10 bps to 2 Mbps) are transported by the multiplexer/demultiplexer (MDM) broadcast communications system (BCS), and type-1 and type-2 interfaces (2 to 50 Mbps) are transported by the high data rate system (STAT MUX) or TV. The MDM's must be configured for the proper bit rate ( $\pm 10$  percent). The MDM operations are automatic (SHO driven) but can be configured manually when equipment malfunctions warrant. MDM's are located at JSC and GSFC. Another satellite link feeds MDM data from GSFC to MSFC. However, MSFC has a direct feed on the STAT MUX link from transponder 3.

## SCHEDULING PROCEDURES

### PRELAUNCH

At approximately L - 21 days, COMMAND prepares the SHO's for the upcoming flight on the user planning system (UPS) terminal using the latest predicted mission AOS/LOS times. These AOS/LOS times are provided by the satellite acquisition (SATACQ) data generated by the TRACK console personnel. Predefined SFWD, S-band return (SRTN), Ku-band forward KFWD, KRTN, and S-band track configuration codes are included with these SATACQ times. The individual SHO's, from prelaunch through mission elapsed time (MET) of 4 days, are transmitted to the NCC SN scheduling department. These schedules/configurations are considered, approved (after resolving conflicts if necessary), and merged into the NCC database with other SN users. Configuration codes define the expected initial configuration for that link, and standard defaults (for KRTN 1.024 MBPS and TV is typical) are usually used. Necessary changes are made in real time via GCMR once a scheduled event has started.

The NCC develops a TDRS network (TN) schedule from all user requests and transmits a forecast mission schedule back to MCC (supposedly conflict free) at launch minus 7 days. Any conflicts are resolved by COMMAND and NCC scheduling. Normally, TDRS is scheduled for the entire mission and conflicts are worked in real time.

At approximately 1 to 2 days before flight, NCC transmits SHO's containing all fixed and reconfigurable parameters for each pass (SHO event) to WSC, where they are stored in the automatic data processing equipment (ADPE), once again assuming no conflicts. A reserve of 12 to 24 hours of SHO's is always stored at WSC to protect for a NASCOM failure.

### DURING THE MISSION

During real-time console operations, INCO and COMMAND coordinate any schedule changes (e.g., normal to early handovers) for upcoming acquisitions over the voice loops. When input to the UPS, these changes are passed to NCC and then to WSC. This process continues until AOS minus 45 minutes. After this time until West AOS minus 20 minutes, INCO must request that a priority request flag be set in the UPS, which results in a priority SHO being transmitted to WSC. Setting this flag should cause no problem. S-band and Ku-band SHO's can still be staggered if necessary, although this is undesirable from a GSFC scheduling standpoint. Configuration changes are handled by GCMR after SHO start instead of UPS, since that method is easier. West to East handover times also cannot be changed after approximately West LOS - 20 minutes to ensure not affecting the nominal West SHO start time. This is due to the inflexibility of the UPS system.

## ACQUISITION PROCEDURES

- COMMAND will ensure that S-band and Ku-band modulation is on and that S-band and Ku-band Doppler compensation is enabled at AOS (or handover time) and that the FEP output bit rate is correct.
- INCO can monitor WSC configuration and return link acquisition on the Telcom SN Status display (this data updates every 5 seconds). Forward and return link DQM is also available on this display.

- If a false lock is suspected, request COMMAND to cycle modulation off/on or to send a reacquisition GCMR for the affected link (e.g., KSA FWD).
- If S-band Doppler tracking has been scheduled (almost always the case), there is no longer any need to remove S-band Doppler compensation; Doppler can be enabled continuously. If the Ku-band is being used for downlink telemetry, there is no longer a need to GCMR for S-band return link mode 3 (carrier only). S-band return link modulation can always remain. Ku-Band channel 1 normally processes data with convolutional coding enabled. In the event of a coding failure, however, the capability remains to process telemetry with coding off as well. This would be done by verbal request to WSC.
- In the event of a dropout, the return link should automatically reacquire on its own. If it does not, request that a return link reacquisition GCMR be sent.
- S-band frequency changes done by GCMR (versus SHO) require a return link reacquisition GCMR.

#### **OTHER GCMR ACTIVITY ASSOCIATED WITH ACQUISITION/REACQUISITION**

##### **A. DOPPLER COMPENSATION**

Carrier Doppler compensation will nominally be scheduled continuously for Ku-band and S-band. S-band spread spectrum Doppler compensation is also always scheduled. International radiation limitation agreements require the normal use of spread spectrum for both S-band and Ku-band. A waiver must be requested from the Consultative Committee for International Radio (CCIR) to radiate with spread spectrum off. This waiver may be requested to allow quicker S-band forward link acquisitions during powered flight.

##### **B. OTHER GCMR's**

Other GCMR's that exist but which are rarely, if ever, used are the Forward Link Sweep Request, Expanded Frequency Uncertainty Request (for a noncoherent return link) and Forward Link EIRP Reconfiguration. These allow changes to the SHO frequencies in the event of unexpected shifts or change in the forward link power levels between normal and high. For shuttle, S-band always uses high power and Ku-band always uses normal power.

#### **RECONFIGURATION PROCEDURES**

##### **A. GENERAL**

The following is a list of ground control interface logic (GCIL) commands and multiple real-time commands (MRTC's) commonly used for orbiter S-band and Ku-band system configuration control.

Note: Refer to section 3 of the INCO System Briefs for additional GCIL command data.

##### **1. DSM 4470 TDRS S-BAND MODE (SALVO)**

XPNDR mode - TDRS  
U/L - LDR ✕  
D/L - LDR ✕  
U/L coding - ON  
D/L coding - ON  
Data source - S-band  
Ranging - DISABLE  
Spread spectrum - ON  
XPNDR - T/R

Return link data - ENABLE  
XPNDR direct - OFF  
XPNDR filter - NARROW ✕

✕ Current TDRS operational philosophy dictates that these functions must be corrected following use of the SALVO. Correct configuration can be attained by using 4470 in an MSPC *FOLLOWED* by DSM 4759 U/L HDR, DSM 4764 D/L HDR, and DSM 4766 U/L filter wide. For real-time commanding, use DSM 4769 TDRS SBD HDR MRTC described in part 5 of this section; MRTC's should be sent two-stage to ensure that all commands get onboard.

2. DSM 4472 STDN HI MODE (SALVO)

XPNDR mode - STDN HI  
U/L - HDR  
D/L - HDR  
U/L coding - OFF  
D/L coding - OFF  
Data source - S-band  
Ranging - ENABLE  
XPNDR - T/R  
Return link data - ENABLE  
XPNDR direct - OFF  
XPNDR filter - WIDE

3. DSM 4471 STDN LOW MODE (SALVO)

XPNDR mode - STDN LOW  
U/L - HDR  
D/L - HDR  
U/L coding - OFF  
D/L coding - OFF  
Data source - S-band  
Ranging - ENABLE  
XPNDR - T/R  
Return link data - ENABLE  
XPNDR direct - ON  
XPNDR filter - WIDE

4. DSM 4473 SGLS MODE (SALVO)

XPNDR mode - SGLS  
U/L - HDR  
D/L - HDR  
U/L coding - OFF  
D/L coding - OFF  
Data source - S-band  
Ranging - ENABLE  
XPNDR - T/R  
Return link data - ENABLE  
XPNDR direct - ON  
XPNDR filter - WIDE

5. DSM 4769 TDRS S-band HDR MRTC

TDRS S-band mode (SALVO - DSM 4470)  
U/L - HDR  
D/L - HDR  
XPNDR filter - WIDE

Note: This MRTC is the one nominally used for configuring for TDRS S-band in all cases. If configuring from Ku-band back to TDRS S-band while Ku-band is still in view and locked, another MRTC can be used to not interrupt the return link as follows:

DSM XXXX  
Data source - S-band  
U/L coding - ON

6. DSM 1500 Ku FWD MRTC

Data source - K-band (ensure command is unsafed)  
U/L coding - OFF

Note: This MRTC can be used when configuring from TDRS S-band (not STDN HI or LO) to Ku-band. Ensure that D/L coding OFF is not in this MRTC, as it is no longer required due to WSC receiver modifications made in early 1996. This MRTC is rarely used with the addition of the automatic Ku handover capability implemented with OI-27.

7. Ku failover to S-band

Note: The following "fail-safe" function is not used with the automatic Ku handover capability implemented in OI-27.

- a. The following conditions must be met to "ARM" the failover function:

<p><b>CAUTION</b></p> <p>The Ku/S failover function will offer no protection unless the conditions listed below are satisfied.</p>
--

- S-band PM mode control (pnl C3) - CMD
  - Ku Signal Processor must be powered (COMM PWR ON)
  - Ku fail-safe - ENABLE with DSM 4140 (GCIL default is to disable)
  - NSP data source - Ku
- b. Once "ARMED," the failover will occur if/when the Ku-band data good bit = failed (V74X2613J = 0, "DATA GD" on the COMM MANAGEMENT display = blank). The following configuration will result.

U/L - LDR

U/L coding - ON

Data source - S-Band

XPNDR mode - TDRS

XPNDR filter - NARROW

Note: A/G2 will not be available until the NSP reconfigured to HDR U/L and D/L.

- c. Ku data good bit will equal zero approximately 13 seconds after the Ku data present bit drops to zero. The Ku data present bit is driven by the logic shown in "d" below. The 13-second delay is a function of the Ku system, not the GCIL. Note that if the Ku data good bit is low when all the conditions in "a" above are met, the failover will occur IMMEDIATELY.
- d. The Ku-band data present bit equals TRUE (1) when all of the following are satisfied .
  - IF Ku system is in the comm mode,  
and FWD link modulation = 1 (data DETECTED on carrier),  
and FWD link carrier = 1 (LOCK, costas lock),  
and (if spread spectrum ON) PN = 1 (LOCK)
  - THEN data present = 1
  - ELSE data present = 0

## B. PROCEDURES

1. To configure from TDRS S-band to STDN S-band to TDRS S-band
  - INCO/COMM SUPPORT advises COMMAND at the earliest practical time of intent to hand down. Verify site and times.
  - COMMAND performs command echo interface checks.
  - COMM SUPPORT verifies correct SM site INH/ENBL status on INCO Management display or equivalent.
  - INST advises DFE at least 1 minute in advance to allow time for reconfiguration of the FEP. Early notification will speed the routing of site data.
  - INCO/COMM SUPPORT selects the technique of configuration change, MRTC or MSPC. The MRTC should be used only if time does not allow the preparation of an MSPC.
  - COMM SUPPORT prepares an MSPC to configure at site AOS time utilizing DSM 4472 (for STDN HI) or 4471 (for STDN LO) and return to TDRS at site LOS with DSM 4470 TDRS S-BAND MODE SALVO, **followed by** DSM's 4759 U/L HDR, 4764 D/L HDR, and 4766 U/L FILTER WIDE. The MSPC should be built with at least 1 second separating each command.

- OR -

  - INCO/COMM SUPPORT issues RTC DSM 4472 or 4471 at site AOS and MRTC DSM 4769 before site LOS. Two-stage auto execution of the MRTC is **required**.
  - COMMAND and DFE configure as requested by COMM SUPPORT and INST.
  - COMM SUPPORT selects cal curve, if required (the Downlink FEP should automatically select the correct curve).
2. To configure from TDRS S-band to SGLS S-band to TDRS S-band
  - INCO/COMM SUPPORT advises COMMAND at the earliest practical time of intent to hand down. Verify site and times.

- COMMAND performs command interface checks.
- COMM SUPPORT verifies correct SM site INH/ENBL status on INCO Management display or equivalent.
- INST advises DFE at least 1 minute in advance to allow time for reconfiguration of the FEP. Early notification will speed the routing of site data.
- INCO/COMM SUPPORT selects technique of configuration change MRTC or MSPC. The MRTC should be used only if time does not allow the preparation of an MSPC.
- COMM SUPPORT prepares an MSPC to configure at site AOS time utilizing DSM 4473 and return to TDRS at site LOS with DSM 4470 TDRS S-BAND MODE SALVO, **followed by** DSM's 4759 U/L HDR, 4764 D/L HDR, and 4766 U/L FILTER WIDE. The MSPC should be built with at least 1 second separating each command.

- OR -

- INCO/COMM SUPPORT issues RTC DSM 4473 at site AOS and MRTC DSM 4769 before site LOS. Two-stage auto execution of the MRTC is **required**.
- COMMAND and DFE configure as requested by COMM SUPPORT and INST.
- COMM SUPPORT selects cal curve, if required (the Downlink FEP should automatically select the correct curve).

3. To configure to alternate S-band XPNDR frequency

- COMM SUPPORT should build a stored program command (SPC) to reconfigure the transponder to low (high) frequency. The best time for execution is during a zone of exclusion (ZOE). See SCP 3.15 MRTC/MSPC Build procedure for information on how to build the SPC.
- Inform COMMAND that an SPC to command to low (high) frequency has been uplinked.

CAUTION

COMMAND will build a GCMR (see SCP 3.1) to reconfigure the TDRS network to low (high) frequency. INCO should wait until COMMAND confirms that the GCMR is built and ready to be shipped out before continuing. If the orbiter is commanded to low (high) frequency before the network is ready, comm will be interrupted.

- Verify that DSM 4740 (4741) is not safed and have COMMAND safe DSM 4741(4740).

CAUTION

The PI transmitter may interfere with the orbiter S-band PM transponder (XPNDR) receiver when the following channels/frequency settings are selected. Interference can be severe enough to capture the XPNDR receiver lock.

<u>IF PI CHANNELS</u>	<u>AVOID XPNDR PM FREQ</u>
000-420, 900-909	LOW
421-882, 910-919	HIGH



- INCO/COMM SUPPORT uplinks the MSPC to reconfigure to low (high) frequency.
- Remind COMMAND to send the GCMR and drop the forward link modulation coincident with the MSPC time-out (if not performed during LOS).
- COMMAND announces when the GCMR has been shipped and accepted.
- COMMAND reapplies forward link modulation when the transponder is locked.
- COMM SUPPORT selects cal curve, if required (the Downlink FEP should automatically select the correct curve).
- Remind COMMAND to send the GCMR to reacquire the return link, if required.

4. To configure from S-band to Ku-band (forward and return links )

Note: The following procedure is not normally used with the automatic Ku handover feature.

- Notify COMMAND and DFE of time of configuration change.
- Verify that DSM 4767 DATA SOURCE - KU is unsafed.
- Ensure that Ku FAIL/SAFE has been enabled. If not, send DSM 4140 KU/S FAIL SAFE - ENA.
- Verify Ku-band DATA GD = GOOD (MSK 921) and Ku in GPC mode.
- Uplink an MSPC containing DSM's 4767 DATA SOURCE Ku, and 4771 U/L CODING OFF.

- OR -

- Send MRTC DSM 1500 MRTC K-band forward, **two-stage**, auto execute.

5. To configure from TDRS Ku-band to S-band (forward and return links )

Note: The following procedure is not normally used with the automatic Ku handover feature..

- Notify COMMAND and DFE of time of intended configuration change.
- Uplink an MSPC containing DSM 4470 TDRS S-BAND MODE SALVO, **followed by** DSM's 4759 U/L HDR, 4764 D/L HDR, and 4766 U/L FILTER WIDE. The MSPC should be built with at least 1 second separating each command. This MSPC will cause a short interruption in the return link as the S-band system reacquires.

- OR -

- INCO/COMM SUPPORT issues MRTC DSM 4769. Two-stage auto execution is required.

-OR-

INCO/COMM SUPPORT issues MRTC XXXX. Two-stage auto execution is **required**. This MRTC will not interrupt the return link but must be used only while Ku-band is still locked, as it will not reconfigure properly following a failover (as would occur during an LOS or ZOE).

6. Following a failover to S-band (GCIL Failsafe Enable):

Note: The following procedure is not used with the automatic Ku handover feature.

- INCO/COMM SUPPORT will direct COMMAND to select U/L LDR in the MCC and GCMR the network to S-band U/L LDR. Uplink modulation should be cycled OFF as the S-band transponder reacquires.
- Monitor for S-band forward link reacquisition.
- When the S-band forward link has reacquired, uplink RTC DSM 4759 to restore full S-band HDR capability. COMMAND must GCMR to U/L HDR to match orbiter configuration and reselect U/L HDR in the MCC.

7. Ku-band mode changes during SHO time (Mode changes before SHO times are voice coordinated with COMMAND. )

a. PM/FM mode changes

- Give COMMAND 3 minutes notice of intentions.
- If TV is desired on channel 3, coordinate with Houston TV with 5 to 10 minutes notice in advance to ensure that the TV longlines are ready and that the WSC TV recorders are set up.
- If FM analog or FM digital is desired on channel 3, inform COMMAND with 5 minutes notice so that WSC may be properly configured. Ku-band return link FM mode changes such as for payload analog, payload digital, or TV can now be done by GCMR in contrast to previous capabilities. However, configuring for bent pipe requires some manual intervention and perhaps 10 minutes advance notice for setting up PSK demods and bit syncs. Also the video/digital switch at WSC is manually configured and requires some advance notice.
- Send DSM 4122 (PM) or DSM's 4123 through 4126 (FM) as desired.
- Ask COMMAND to send the GCMR immediately after end item response confirmation.
- Monitor the Telcom SN Status display for proper return link reacquisition.

b. Channels 2 and 3 bit rate changes

- Give COMMAND 3 minutes notice of intentions. Channel 2 can be reconfigured independently of the other two channels once the TDRS Resource Management (TRM) software is delivered in the MCC. If TRM is unavailable, request a verbal GCMR to avoid dropouts on the other 2 channels.
- COMMAND will send the appropriate GCMR for channel 2 or 3.
- Start the dump or notify the customer when COMMAND and DFE confirm proper configuration.
- Monitor for proper reacquisition (the Telcom SN Status display for bit sync and the Dump FEP Status display for dump data quality).
- It is also important to remember that data code must be configured properly for channels 2 and 3 as follows (jitter settings are not as critical):

	Jitter, %	Code
Channel 2 dumps (SSR, OPS or PL recorder)	2	Biphase-L
Channel 2 digital data	0.1	NRZ-L
Channel 3 digital data	0.1	NRZ-L

- ❑ Inform COMMAND of the proper code when you give him your intentions and he will configure properly via GCMR.
- ❑ For SSR or OPS RCDR dumps, channel 2 should be configured for the actual bit rate; i.e., 960 kbps or 1024 kbps (default is 1024 kbps). The channel 2 DQM will always be set up to be accurate for both forward and reverse dumps and for both bit rates.

C. OTHER CONSIDERATIONS

- The WSC MRD Ku-band subcarrier lock status indication updates only every 15 seconds because of the ADPE polling frequency. Therefore, use bit sync status in the ODM's as your prime indication of return link modulation status when in the FM mode. Carrier lock is unavailable in the FM mode, only in PM. Subcarrier signal strength is unreliable and should not be used.
- TDRS West/East handovers will be scheduled to occur at a specific time for S-band and for Ku-band. S-band handover can precede, equal, or follow Ku-band handover, but both times must be specifically scheduled. Since the West satellite support normally goes away once the handover time has occurred, onboard antenna management for both S-band and Ku-band must be configured properly to stay in sync with TDRS scheduling. Simultaneous SHO's for Ku-band are difficult to schedule and should not, as a rule, be requested. Simultaneous SHO's for S-band can be scheduled, but this is only planned during the entry rev because of typical conflicts for usage in the TDRSS system.
- Experience has shown that more reliable TDRSS Ku-band pointing is obtained when autotrack is disabled. Autotrack enable/disable is reconfigurable via GCMR originating only in the NCC (voice call from MCC COMMAND to NCC). The default mode is autotrack disable.
- TDRS normally can support digital data up to 10 Mbps on Ku-band channel 3 in the FM mode. To accommodate users of the orbiter "bent pipe" mode, PSK demods and bit syncs have been installed (1024 kbps max.), which will allow channel 3 digital data to be processed and to be put on an MDM channel similar to channel 2. These must be manually configured.

#### 7. TDRS Z (ZOE) operations

Currently, there is a TDRS satellite (TDRS Z) located at 85° East (or 275° West) that can be scheduled to provide communications support through the Zone of Exclusion (ZOE). The satellite control and telemetry routing is performed at a ground station located at Guam, and data is processed remotely from the Guam Remote Ground Terminal (GRGT) to WSC. The ground site has been upgraded with excess WSC equipment to support a space shuttle S-band forward and return link (Ku-band is available, but the bandwidth limitation between Guam and WSC only allows for up to 1024 Kbps of channel 2 data).

Both the SM and BFS software have been updated to easily utilize the -275 vector for pointing to the satellite.

**TITLE**

ANTENNA MANAGEMENT: COMM LINK HANDOVER COMMAND PROCEDURES

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed premission without review and approval at the FOIG.

**PURPOSE**

To define a standard set of procedures for performing radio frequency (RF) link handovers using uplink commands to change the TDRS or ground site selection criteria in SM and/or BFS antenna management software.

**RESTRICTIONS & CONSTRAINTS**

These procedures are only valid in all ops modes of the SM and the BFS major functions. Some of these procedures require that the crew not have SPEC 60 active. The panel C3 Sband PM Antenna switch must be in GPC for these procedures to be effective.

**GENERAL**

The crew does not have the time to manage the TDRS or Ground site communications link handovers. The ground has the capability to relieve the crew of any actions related to comm link handovers and is considered by the crew and other flight controllers to be responsible for any and all comm link handovers. The following procedures are used to execute handovers for TDRS and ground sites for both the SM and BFS major functions

**PROCEDURE**

The following procedures are divided into two sections. One section will discuss TDRS handovers for both SM and BFS while the other section will discuss ground site handovers for both SM and BFS.

**A TDRS Handovers**

The following paragraphs contain brief discussions about how the antenna management software works in the SM and BFS as well as procedures for executing the 3 different types of TDRS communications link handovers.

**1. TDRS Antenna Management Software**

Antenna Management (AM) is handled differently in the two major functions. The following are brief discussions on the different ways each AM cycle works.

**CAUTION:**

The default TDRS state vectors are in the wrong order for "Normal" handovers for the BFS until OI 29. The TDRS state vectors should be uplinked, post MECO, with the order being slot 1 TDRS 171° or 174°, slot 2 TDRS 47° or 41°, slot 3 TDRS 275°.

The SM AM software has 4 TDRS state vector slots. Each slot requires a command to change its values. Each slot can be enabled for use or inhibited from use by ground command only. A priority technique is available in the SM to allow for early handovers. Default configuration has slot 1 as target A and slot 2 as target B. Any slot can be assigned as A or B via crew item entry or ground command. If AM is configured to A pri by the crew or ground command, and if the associated slot is in view it will be selected until it is no longer in view, then target B will be selected (if in view). If AM is configured to B pri by the crew or ground command, and if the associated slot is in view it will be selected until it is no longer in view, then target A will be selected (if in view). If neither target A or B is in view then the lowest numbered slot that is in view will be selected. The following commands are used to manage the SM antenna management software. They can be uplinked real-time or stored as TECs:

<u>DSM</u>	<u>Title</u>
14001	SM S-BD ANT PTG INH
14003	KU-BD TDRS TGT-A PRI
14004	KU-BD TDRS TGT-B PRI
14009	S-BD TDRS TGT-A PRI
14010	S-BD TDRS TGT-B PRI
14033	SM S-BD ANT PTG ENBL
14049	TDRS VECTR 1 TO TGT-A
14050	TDRS VECTR 2 TO TGT-A
14051	TDRS VECTR 3 TO TGT-A
14052	TDRS VECTR 4 TO TGT-A
14053	TDRS VECTR 5 TO TGT-A (OI 29 and subs)
14054	TDRS VECTR 6 TO TGT-A (OI 29 and subs)
14055	TDRS VECTR 1 TO TGT-B
14056	TDRS VECTR 2 TO TGT-B
14057	TDRS VECTR 3 TO TGT-B
14058	TDRS VECTR 4 TO TGT-B
14059	TDRS VECTR 5 TO TGT-B (OI 29 and subs)
14060	TDRS VECTR 6 TO TGT-B (OI 29 and subs)
14061	TDRS VECTOR 1 ENA
14062	TDRS VECTOR 2 ENA
14063	TDRS VECTOR 3 ENA
14064	TDRS VECTOR 4 ENA
14065	TDRS VECTOR 5 ENA (OI 29 and subs)
14066	TDRS VECTOR 6 ENA (OI 29 and subs)
14067	TDRS VECTOR 1 INH
14068	TDRS VECTOR 2 INH
14069	TDRS VECTOR 3 INH
14070	TDRS VECTOR 4 INH
14071	TDRS VECTOR 5 INH (OI 29 and subs)
14072	TDRS VECTOR 6 INH (OI 29 and subs)

a. BFS Major Function

The BFS AM process is very simple. The lowest numbered TDRS state vector slot that is in view will be selected each AM cycle.

**NOTE:** A problem was found during testing. The BFS will only maintain 1 TDRS state vector command until it sees the S band transponder in TDRS mode. The procedure to work around this problem is to uplink the eastern TDRS that is planned to be used at the

same time as the other pre flight loading commands. After MECO the entire TDRS state vector set will be uplinked.

1. Normal Handovers

An example of a "Normal" handover would be at LOS of the current state vector slot, another slot that is in view would be selected. No action is necessary to execute a normal handover unless "Early" or "Mid-pass" handovers were previously executed.

a. SM

Step	Action	Response
1	Verify the TDRS support plan via the Schedule of Handover Operations (SHO)	
2	Verify that targets A and B are assigned to the correct TDRS slots and that TECs are on board to go back to "A Pri" for both S Band and Ku Band, 10 minutes before the end of the previous eastern TDRS pass. (cmd buffers display)	

b. BFS

Step	Action	Response
1	Verify the TDRS support plan via the Schedule of Handover Operations (SHO)	
2	If an "Early" handover was executed during the previous TDRS pass, uplink <b>403xx</b> to put TDRS 171° or 174° into slot 1 after LOS of TDRS 171°.	

2. Early Handovers

An example of an "Early" handover would be while selecting the current state vector slot, another slot comes into view. Once that other slot is in view, it is selected. No action is required to perform an early handover if the previous orbit was an early handover using the same satellites.

a. SM

Step	Action	Response
1	Verify the TDRS support plan via the Schedule of Handover Operations (SHO)	
2	Verify targets A and B are assigned to the appropriate TDRS state vector slots.	Workstation Antenna Management System (WAMS) display shows target A and B in the appropriate TDRS slots

Step	Action	Response
3	Use RF CMD BUILD application to build TEC 134xx target A to vector slot X (1 –6) to execute 10 minutes before LOS of the Eastern TDRS just before the “Early” handover pass.	RF CMD BUILD shows the TECs built at the appropriate times
4	Have INCO verify the TECs	INCO verifies the TECs
5	Uplink TECs	TEC buffer count increments by 2. Cmd buffers display shows the extra TECs onboard.

b. BFS

The TEC buffer is not available in the BFS major function, therefore care must be taken with this procedure since commands must be executed real-time.

Step	Action	Response
1	Verify the TDRS support plan via the Schedule of Handover Operations (SHO)	
2	Use the RF CMD BUILD application to build 403xx to put TDRS 41° or 47° into TDRS slot 1 and TDRS 171° or 174° into TDRS slot 2	RF CMD BUILD display shows TDRS 41° or 47° in slot 1.
3	Have INCO verify the TDRS state vector commands	
4	INCO uplinks 403xx (Western TDRS in slot 2) then 403xx (Eastern TDRS in slot 1) well before AOS of the Eastern TDRS.	Possible short telemetry drop while BFS selects slot 2 for AM. At the Eastern TDRS AOS, slot 1 will be selected.
5	After handover back to the Western TDRS after the early handover. Clean up the TDRS slots by uplinking the Western TDRS in slot 1 and Eastern TDRS in slot 2.	Nominal TDRS config displayed on WAMS

3. Mid-pass Handovers

A “Mid-pass” handover will occur when 2 or more state vector slots are in view and the second slot must be selected after it is AOS but before the first slot is LOS.

a. SM

Step	Action	Response
1	Verify the handover plan with COMMAND	COMMAND checks the TDRS schedule of handover operations (SHO)



Step	Action	Response
2	Use RF CMD BUILD display to build TEC <b>134xx</b> target A to vector slot X (1 –6) to execute at handover time.	RF CMD BUILD shows the TECs built at the appropriate times
3	Have INCO verify the times with the Satellite Acq Time display	INCO verifies the times
4	Uplink TECs	TEC buffer count increments by 2. Cmd buffers display shows the extra TECs onboard.

b. BFS

Step	Action	Response
1	Verify the TDRS support plan via the Schedule of Handover Operations (SHO)	
2	Use the RF CMD BUILD application to build <b>403xx</b> to put TDRS 41° or 47° into TDRS slot <b>1</b>	RF CMD BUILD display shows TDRS 41° or 47° in slot 1.
3	Have INCO verify the TDRS state vector command	
4	INCO will configure for “ <b>MANUAL EXEC</b> ” and <b>BFS</b> major function, then uplink <b>403xx</b> (Eastern TDRS in slot 1)	Uplink buffers display shows the command data words in the uplink and downlink columns
5	Just before the handover time, INCO presses the “ <b>2 STG EXEC</b> ” button.	Telemetry will drop out until the eastern TDRS even starts. WAMS will show slot 1 selected.
6	After LOS of the Western TDRS clean up the TDRS slots by uplinking the Western TDRS in slot 1.	Nominal TDRS config displayed on WAMS.

B. Ground Site Handovers

1. Ground Site Antenna Management

Ground site management is generally used to support Ops recorder dumps while on orbit or operational data during ascent/entry times. The BFS and the SM handle ground sites differently. The following paragraphs document the standard procedures for ground site management.

a. SM Major Function

The SM major function has two methods for ground site handovers. One method uses a command that may be stored in the TEC buffer or uplinked real-time. The primary method used is real-time uplink. The following is the standard procedure for enabling and inhibiting sites as well as site-to-site handovers.

Step	Action	Response
1	Request permission from INCO to inhibit ground sites	INCO concurs
2	Verify SPEC 60 is not active on the workstation display inst_mgmt	
3	Uplink Inhibit commands for any ground sites that will not be used to support shuttle activities. (see table 3.7-1 for commands)	Comm_mgmt and inco_mgmt will show the enabled ground sites.
4	At site handover time, uplink <b>14012</b> to the SM major function to select the next ground site (if required)	WAMS (real-time), comm_mgmt and inco_mgmt will show the currently selected ground site change to the next available site.

DSM	Title	DSM	Title
12201	MIL INH	12217	MIL ENA
12202	NHS INH	12218	NHS ENA
12203	OTS INH	12219	OTS ENA
12204	DGS INH	12220	DGS ENA
12205	GTS INH	12221	GTS ENA
12206	HTS INH	12222	HTS ENA
12207	VTS INH	12223	VTS ENA
12208	DFR INH	12224	DFR ENA
12209	CTS INH	12225	CTS ENA
12210	JSC INH	12226	JSC ENA
12211	MAD INH	12227	MAD ENA
12212	GDX INH	12228	GDX ENA
12213	CAN INH	12229	CAN ENA
12214	WLP INH	12230	WLP ENA
12215	SITE 15 INH	12231	SITE 15 ENA
12216	SITE 16 INH	12232	SITE 16 ENA

Table 3.7-1 SM Site Enable/Inhibit commands

b. BFS Major Function

The BFS requires the S-Band transponder to be in either STDN or SGLS mode before it will select ground sites for antenna pointing. The BFS only uses TMBUs for inhibiting sites. The process of enabling a site is to uplink a TMBU that does not include the site as inhibited.

Step	Action	Response
1	Request from INCO permission to inhibit ground sites	INCO concurs
2	Uplink Inhibit TMBU that contains the sites to be inhibited. (see table 3.7-2 for commands)	asc_ent_comm_mgmt and asc_ent_inco_mgmt displays will show the enabled ground sites.

<b>DSM</b>	<b>Title (for STS 104)</b>
12345	PDL Enable for prelaunch
12346	Nominal Ascent/Entry
12347	WLP Enabled
12348	NHS Enabled
12349	JDI Enabled
<b>DSM</b>	<b>Title (for STS 105 and subs)</b>
12401	BFS AM ASCENT NOMINAL
12402	BFS AM ASCENT WLPS
12403	BFS AM ASCENT NHS
12404	BFS AM ASCENT PDL
12405	BFS AM ASCENT JDI
12410	BFS AM ORBIT ALL RTS
12411	BFS AM ORBIT STDN/RTS
12420	BFS AM ENTRY NOMINAL
12421	BFS AM ENTRY MIL CONT
12434	BFS AM ALL SITES ENA
12435	BFS AM MIL ONLY ENA
12436	BFS AM PDL ONLY ENA
12437	BFS AM DFR ONLY ENA
12438	BFS AM WLP ONLY ENA
12439	BFS AM JDI ONLY ENA
12440	BFS AM CTS ONLY ENA
12441	BFS AM GTS ONLY ENA
12442	BFS AM HTS ONLY ENA
12443	BFS AM VTS ONLY ENA
12444	BFS AM OTS ONLY ENA
12445	BFS AM DGS ONLY ENA
12446	BFS AM NHS ONLY ENA
12447	BFS AM MAD ONLY ENA
12448	BFS AM GDX ONLY ENA
12449	BFS AM CAN ONLY ENA
12450	BFS AM JSC ONLY ENA

Table 3.7-2 BFS Ground Site Inhibit TMBU Commands

C. Crew Capabilities

The crew has some limited capabilities to manipulate the AM sequence via SPEC 201 Antenna in the SM major function and SPEC 51 Override in the BFS major function. The following paragraphs describe these capabilities.

1. SM SPEC 201 Antenna (**OI 28**)

The following is a listing of the item entries the crew can use to affect changes in AM.

ITEMS 1 through 4 TDRS TGT SELECT A or B –used to assign any of the 4 TDRS state vectors, to targets A or B. An ‘\*’ is displayed in the ‘A’ column adjacent to the TDRS state vector slot number (1 –4), if that TDRS state vector slot is selected as the ‘A’ target. An ‘\*’ is displayed in the ‘B’ column adjacent to the TDRS state vector slot number (1 –4), if that TDRS state vector slot is selected as the ‘B’ target. Only one TDRS state vector slot can be assigned to target ‘A’ or ‘B’ at a time. The same TDRS state vector slot can be assigned to both ‘A’ and ‘B’.

- ITEMS 5 and 6 RDR RNG –used to control the range estimate output (AUTO or MIN) to the Ku-band Rendezvous Radar/COMM A system. An '\*' is displayed next to the selected item. Initialization is in AUTO.
- ITEM 7 SELF- TEST –used to select or terminate the radar self-test function. An '\*' appears next to item 7 when the self-test is selected. After the 3-minute test is completed, item 7 must be re-executed to deselect the self-test function and blank the test results (displayed on the Range meter on panel A2).
- ITEM 8 I/O RESET KU –used to initiate communications between the SM GPC and the Ku-band system. An '\*' is displayed next to the item whenever the interface is enabled otherwise an 'M' is displayed. When the SM is initialized the interface is enabled.
- ITEM 9 and 10 TDRS KU PRI A/B –Item 9 allows the SM Antenna Management (AM) software to select TDRS target 'A' for primary pointing of the Ku-band Comm antenna, if it is in view. If target 'A' is not in view but target 'B' is in view, the target 'B' TDRS satellite will be utilized for pointing. If neither target 'A' nor 'B' is in view, the lowest numbered TDRS state vector slot in view and enabled will be utilized for pointing (as denoted by the '\*' located in the 'IN VIEW' column of the TDRS STATE VECTORS table). Item 10 allows AM to select TDRS target 'B' for primary pointing if it is in view. If target 'B' is not in view but target 'A' is in view, the target 'A' TDRS satellite will be utilized for pointing. If neither is in view the lowest numbered slot in view and enabled will be used for pointing. An '\*' is displayed next to the selected item entry. Initialization is in TDRS Ku A PRI.
- ITEM 11 and 12 GPC ANT CMD ENA/INH –used to enable or inhibit AM selection of S-band antennas. An '\*' is displayed next to the selected function. ENA is selected at SM initialization.
- ITEM 13 OVRD –used to force AM to TDRS mode and remain there. This will allow AM to select the best S-Band antenna to TDRS even if there is a status problem preventing AM from knowing what is the correct mode. An '\*' is displayed next to the item when it is enabled. The display is initialized with item 13 inhibited.
- ITEM 14 and 15 TDRS S-Band PRI A/B –works the same as the Ku-band PRI A/B function but for the S-Band antennas.

## 2. SM SPEC 201 Antenna (OI 29)

The following is a listing of the item entries the crew can use to affect changes in AM.

- ITEMS 1 through 6 TDRS TGT SELECT A or B –used to assign any of the 6 TDRS state vectors, to targets A or B. An '\*' is displayed in the 'A' column adjacent to the TDRS state vector slot number (1 –6), if that TDRS state vector slot is selected as the 'A' target. An '\*' is displayed in the 'B' column adjacent to the TDRS state vector slot number (1 –6), if that TDRS state vector slot is selected as the 'B' target. Only one TDRS state vector slot can be assigned to target 'A' or 'B' at a time. The same TDRS state vector slot can be assigned to both 'A' and 'B'.
- ITEM 7 SELF- TEST –used to select or terminate the radar self-test function. An '\*' appears next to item 7 when the self-test is selected. After the 3-minute test is completed, item 7 must be re-executed to deselect

- the self-test function and blank the test results (displayed on the Range meter on panel A2).
- ITEM 8 I/O RESET KU –used to initiate communications between the SM GPC and the Ku-band system. An ‘\*’ is displayed next to the item whenever the interface is enabled otherwise an ‘M’ is displayed. When the SM is initialized the interface is enabled.
- ITEM 9 and 10 TDRS KU PRI A/B –Item 9 allows the SM Antenna Management (AM) software to select TDRS target ‘A’ for primary pointing of the Ku-band Comm antenna, if it is in view. If target ‘A’ is not in view but target ‘B’ is in view, the target ‘B’ TDRS satellite will be utilized for pointing. If neither target ‘A’ nor ‘B’ is in view, the lowest numbered TDRS state vector slot in view and enabled will be utilized for pointing (as denoted by the ‘\*’ located in the ‘IN VIEW’ column of the TDRS STATE VECTORS table). Item 10 allows AM to select TDRS target ‘B’ for primary pointing if it is in view. If target ‘B’ is not in view but target ‘A’ is in view, the target ‘A’ TDRS satellite will be utilized for pointing. If neither is in view the lowest numbered slot in view and enabled will be used for pointing. An ‘\*’ is displayed next to the selected item entry. Initialization is in TDRS Ku A PRI.
- ITEM 11 and 12 GPC ANT CMD ENA/INH –used to enable or inhibit AM selection of S-band antennas. An ‘\*’ is displayed next to the selected function. ENA is selected at SM initialization.
- ITEM 13 OVRD –used to force AM to TDRS mode and remain there. This will allow AM to select the best S-Band antenna to TDRS even if there is a status problem preventing AM from knowing what is the correct mode. An ‘\*’ is displayed next to the item when it is enabled. The display is initialized with item 13 inhibited.
- ITEM 14 and 15 TDRS S-Band PRI A/B –works the same as the Ku-band PRI A/B function but for the S-Band antennas.
- ITEMS 16 and 17 RDR RNG –used to control the range estimate output (AUTO or MIN) to the Ku-band Rendezvous Radar/COMM A system. An ‘\*’ is displayed next to the selected item. Initialization is in AUTO.

### 3. BFS SPEC 51 Override

The following is a listing of the item entries the crew can use to affect changes in AM.

- ITEM 46 TDRS –used to configure the comm systems to communicate with TDRS. In Ops 1 and 6 S band spreading will be commanded off. In Ops 3 S band spreading will be commanded on.
- ITEM 47 STDN-HI –used to configure the comm systems to communicate, in high power mode, with STDN ground sites. In Ops 1 and 6 Uplink coding will be commanded ON. In Ops 3 uplink coding will be commanded OFF.
- ITEM 48 STDN-LO –used to configure the comm systems to communicate, in low power mode, with STDN ground sites. In Ops 1 and 6 Uplink coding will be commanded ON. In Ops 3 uplink coding will be commanded OFF.

ITEM 49 SGLS –used to configure the comm systems to communicate with RTS (U.S. Air Force) ground sites.

**NOTE:** If the flight critical MDM used for commanding (FF1 with NSP1 and FF3 with NSP 2) is bypassed by the BFS the item entries listed above will not take affect until the bypass is cleared.

D. AM Pointing Enable/Inhibit

Both the SM and BFS can be forced to inhibit auto antenna selects so that the ground can take manual (command) control of the S-Band quad and hemi antennas. The following paragraphs explain this capability for both major functions.

1. SM

Uplink DSM 14033 to enable SM automatic antenna selection

Uplink DSM 14001 to inhibit SM automatic antenna selection

2. BFS

**(for STS 105 and subs)**

Uplink DSM 12432 to enable BFS automatic antenna selection

Uplink DSM 12433 to inhibit BFS automatic antenna selection

**(STS 104 is the last flight to use the following DSMs)**

Uplink DSM 12439 to enable BFS automatic antenna selection

Uplink DSM 12440 to inhibit BFS automatic antenna selection

**TITLE**

LOSS OF S-BD U/L DUE TO TDRS CARRIER ONLY DOPPLER TRACKING

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**BACKGROUND**

The S-band transponder design has a GCIL/PNL control function to disable downlink (D/L) data. Since the transponder uplink (U/L) and D/L control systems use the same circuits, the loss of U/L can occur whenever NSP's are switched while D/L data is disabled. This is usually done for the purpose of providing TDRS carrier only Doppler tracking.

**CAUTION**

Loss of all uplink (command and voice) may occur if this procedure is not followed.

Figure 3.8-1 shows the command procedure restrictions.

---

**COMMAND RESTRICTIONS/CONSTRAINTS**      CMD CR# BASELINE      DATE: 11/12/87

1. Hazard/safety implication (should/are safed?): No
2. Valid software major modes (if applicable, include OPS Mode X01, X02....):

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC	X									
SM	X									
BFS	X									
PL										
OPS 0										

3. Valid OI loads: All
  4. Vehicle, LRU/hardware version constraints: None
  5. Time constraints, crew coordination requirements: None
- 

**Figure 3.8-1. Command restrictions/constraints**

## **PROBLEM**

If command DSM 4737 (S-BD MODE - TDRS TRK) has been sent to support Doppler Tracking and NSP's are subsequently switched, the transponders will be configured to route U/L data to the unselected NSP, and a loss of S-band U/L will occur. This can be prevented by initially enabling S-band R/L data prior to switching NSP's.

## **PROCEDURE**

Send DSM 4744 - S-band R/L DATA - ENA  
Switch NSP's

If TDRS carrier only, Doppler tracking still required,  
Send DSM 4737 - S-BD MODE - TDRS TRACK

## **CREW RECOVERY**

U/L will be recovered when an S-band PNL/CMD is performed per the procedures.

Note: The TDRS Salvo command (DSM 4470) used in the STANDARD SPC's will also recover the U/L.





**TITLE**

GENERIC COMMAND SYSTEM: TFL/DFL OP CODE UPLINK PROCESSING  
(INST CMD BUILD - GCS)

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

To define a standard set of procedures for sending Telemetry Format Loads (TFLs) to the PCMMU and Data Format Loads (DFLs) to the PDI, using ground-initiated OP code uplink.

**GENERAL**

The command restrictions/constraints for this SCP are shown in Figure 3.9-1.

COMMAND RESTRICTIONS/CONSTRAINTS

1. Hazard/safety implication (should/are safed?): None
2. Valid software major modes (if applicable, include OPS Mode X01, X02....):

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC										X
SM			X		X					
BFS										
PL										
OPS 0										

3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None (TFL/DFL OPS use mass memory unit. Check with DPS if MMU problems exist.)
5. Time constraints, crew coordination requirements: Crew must not have SM SPEC 62 up when uplinking TFL/DFL OP codes. Verify the status of SPEC 62 by using inst\_mgmt display to determine if SM VP slot 5 shows active (displays "SPEC 62" in yellow letters, value = 1) or inactive (blank, value = 0). SM common buffer must not be busy when commencing uplinks of TFL/DFL OP codes.

**Figure 3.9-1. Command restrictions/constraints TFL/DFL**

TFLs are used to program two of the three formatters in the Pulse Code Modulation Master Unit (PCMMU). These formats are used to select and sort the data which will be downlinked from the shuttle to the ground. The DFLs are used to decommutate the data from a payload in the Payload Data Interleaver (PDI). The FPMs are used to integrate the decommutated payload data into a stream that the PCMMU can incorporate in the overall telemetry stream that it is downlinking. The following procedures explain how to build the commands which load the TFLs in the PCMMU and the DFLs and FPMs into the PDI.

**PROCEDURE**

A. To build TFL command loads using INST CMD BUILD Display

SEQ	Initiator	Action	Comments
1	INST	Call up the INST CMD BUILD display from the INCO GCS DNAV menu and select the TFL/DFL option from the Command Types menu	
2	INST	Enter a valid DSM number (12501 - 12599), along with a title (such as "TFL 184" or "TFL 184/103" etc.). The title can be any character string up to 21 characters long	
3	INST	If the DSM selected is an existing command load in the server, the DELETE LAST button must be used to clear the contents of the command before continuing	
4	INST	For a High Data Rate (HDR) TFL, select the format from the HDR list of valid formats. The range is 128-254	The right side of the display will show the onboard item entries required to load the TFL in the PCMMU.
5	INST	For a Low Data Rate (LDR) TFL, select the format from the LDR list of valid formats. The valid LDRs are 102 and 103	The right side will show the LDR format. Both the HDR and LDR can be built in the same command.
6	INST	From the Operations menu on the TFL/DFL build display, select the "Submit" option	Messages will appear at the bottom of the display to tell the user that the command server has accepted the command. The green "Edited" light will disappear.
7	INST	If there was a command already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press "Yes" to replace the command in the server	

Note: If only an HDR TFL is built and uplinked, expect a Telemetry Reject (TMRJ) that should be cleared by a Compare Initiate command once the TFL load process is completed. LDR and

HDR can be combined into one command load. It is recommended that the LDR be placed in the load first so that there will be no possibility of a TMRJ on the command because of the first step being a change to fixed format.

B. To build DFL command Loads using INST CMD BUILD display

SEQ	Initiator	Action	Comments
1	INST	Call up the INST CMD BUILD display from the INCO GCS DNAV menu and select the TFL/DFL option from the Command Types menu	
2	INST	Enter a valid DSM number (12501 - 12599), along with a title (such as "DCM 1 FMT 6 SRC 3"). The title can be any character string up to 21 characters long	
3	INST	If the DSM selected is an existing command load in the server, the DELETE LAST button must be used to clear the contents of the command before continuing	
4	INST	Select the Decom from the list of valid decom numbers. The range is 1-4	The right side of the display will show the selected decom in the PDI
5	INST	Select the format from the list of valid DFL format. The range is 1-31	The right side will show the format ID
6	INST	Select the input source of the payload data from the list of valid SRCs. The range is 0-6	The right side will show the source ID
7	INST	From the Operations menu on the TFL/DFL build display, select the "Submit" option	Messages will appear at the bottom of the display to tell the user that the command server has accepted the command. The green "Edited" light will disappear
8	INST	If there was a command already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press "Yes" to replace the command in the server	

Note: Not all the steps listed above must be executed. The minimum required steps to change a format in a decommutator are 1-5 and 7. To simply change a source in the decommutator, the minimum steps are 1-4, 6 and 7. Before uplinking a new FMT or SRC, be sure the decom the FMT or SRC will be placed into is FDA disabled or a message will be generated onboard.

C. To build FPM command loads using INST CMD BUILD display

SEQ	Initiator	Action	Comments
1	INST	Call up the INST CMD BUILD display from the INCO GCS DNAV menu and select the TFL/DFL option from the Command Types menu	
2	INST	Enter a valid DSM number (12501-12599), along with a title (such as "FPM 501"). The title can be any character string up to 21 characters long	
3	INST	If the DSM selected is an existing command load in the server, the DELETE LAST button must be used to clear the contents of the command before continuing	
4	INST	Select FPM from the list of valid decom numbers	The right side of the display will show a "5" for the selected decom in the PDI
5	INST	Select the format from the list of valid DFL format. The range is 501-525	The right side will show the format ID
6	INST	From the Operations menu on the TFL/DFL build display, select the "Submit" option	Messages will appear at the bottom of the display to tell the user that the command server has accepted the command. The green "Edited" light will disappear
7	INST	If there was a command already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press "Yes" to replace the command in the server	

D. Function ID Definitions

Whenever a command load is built with the TFL/DFL build tool, the right side of the display will show the function codes used to make the requested change happen onboard. The following list shows the function codes and what they are used for.

Function ID no.	Description of function
01	Selects the fixed HDR downlink formatter (TFL = 129)
02	Selects the programmable HDR downlink formatter. (A TFL must have been loaded into the programmable (soft) formatter before this option should be used)
03	Selects a TFL to be loaded into the LDR or HDR formatter. Valid LDR formats are 102 and 103 (limited by the display). Valid HDR formats are 128 - 254
04	Actually loads the selected TFL into the formatter
05	PCMMU I/O reset, resets the bypassed TIO/SVC read tables in the SM GPC
06, 07	PSP 1(2) I/O reset, resets the interface between the SM GPC and the PSP. The PSP must be turned on before this can be done.
08	PDI I/O reset resets the bypass indicator for the SM PDI switch matrix read
09	Selects the desired PDI decom to be loaded (format, source, or both). This function will have a decom number displayed. 1-4 for decoms and 5 for FPM
10	Selects the format to be loaded into the selected decom. Valid DFLs are 00-31. Valid FPMs are 501 - 525 (limited by the display)
11	Actually loads the previously selected DFL/FPM
12	Selects the input source for the previously selected decom. Valid range is 0 to 6. Note that a source of 0 will effectively disable the decom
13	Actually loads the previously selected input source into the previously selected decom
14, 15, 16, 17	Toggles the FDA enable/disable bin for PDI decoms 1, 2, 3, and 4, respectively

E. Predefined 125 load class commands

DSM no.	Function no.	Description	Device
12538	2	Selects the programmable HDR formatter	PCMMU
12539	1	Selects the fixed HDR formatter (TFL 129)	PCMMU
12540		Load TFLs 161 and 103	PCMMU
12541	14	Toggle Enable/Disable FDA on decom 1	PDI
12542	15	Toggle Enable/Disable FDA on decom 2	PDI
12543	16	Toggle Enable/Disable FDA on decom 3	PDI
12544	17	Toggle Enable/Disable FDA on decom 4	PDI
12545		Loads TFL 163 PL9, M/M Dump	PCMMU

DSM no.	Function no.	Description	Device
12546		Loads TFL 164 and 102	PCMMU
12547	6	PSP 1 I/O reset	PSP 1
12548	7	PSP 2 I/O reset	PSP 2
12549	8	Reset switch element bypass indicator (I/O reset)	PDI
12550	5	Reset element bypass indicators (I/O reset)	PCMMU

F. To uplink a TFL/DFL command

SEQ	Initiator	Action	Comments
1	INST	Call up the INST CMD BUILD display from the INCO GCS DNAV menu and select the TFL/DFL option from the Command Types menu	
2	INST	Verify that the DSM number and contents of the command are correct and request INCO's concurrence	
3	INST	Select SM Major function and Load mode on the DSM panel of the hardware or software command panels	
4	INST	Verify that the two stage buffer is not being used, SPEC 62 is not active, and the SM common buffer is not busy	
5	INST	Dial in the load number 125xx (where xx is from 01 to 99) on the DSM panel of the hardware or software command panels	
6	INST	Press the command init button on the DSM panel. Monitor the two-stage process for errors	
7	INST	Monitor pertinent downlink telemetry for each function of uplinked load √ TFL STAT = 01, then 02 √ On Orbit Fault Message display for no "I/O ERROR MMU" message	If an MMU message appears, contact DPS and advise them of the problem. If a TFL load fails, reinitiate load. If TFL LOAD REJECT indicator is illuminated, recheck load contents, correct the load, and retransmit the load. A TFL Load Reject will occur if SPEC 62 is up
8	INST	If necessary, press the Compare Initiate button to complete the buffer execute command	A TMRJ may occur on the buffer execute command because the SM downlist will be interrupted while the TFL is being loaded

**CAVEATS AND NOTES**

Any and all references to any specific DSM numbers referenced herein are correct at the origination date. Users are cautioned to check the functions versus DSM numbers prior to use because the loads can change DSM numbers, be deleted, etc.

If multiple functions are uplinked in a single load, the SM GPC will work them off one at a time until all have been done. If any MMU transactions are involved (TFLs or DFLs), the load may take anywhere from 5 to 60 seconds to complete. For further information on the exact format of the uplink load, see Systems Brief on COMMAND (INCO/COMM Systems Brief).

Following are the restrictions on use of PDI/PCMMU OP code load uplinks. Do not attempt a PCMMU/PDI load uplink while SM SPEC 62 is called up or overlayed on any DEU aboard the orbiter. If such an uplink is attempted while the SPEC is up, the entire load will be rejected. If the load contains an illegal number of data sets (data sets >10), the load will be rejected. Any data set in the load containing an illegal function ID or format ID will be rejected, along with any subsequent data sets.

**CAUTION**

Do not uplink TFL/DFL loads while in TFL 129 (Fixed HDR Format). This would require manually executing the two-stage buffer in the absence of an SM downlist, which requires explicit Flight Director approval, per Flight Rule 11-19.

The following conditions cause failure of TFL/DFL loads; listed indications are noted.

<b>Condition</b>	<b>Indication</b>	<b>Results</b>
Undefined TFL ID	TFL FAIL	PCMMU retains previous TFL value
Undefined DFL ID	None	PDI retains previous DFL value
Invalid TFL ID	TFL FAIL	Processing of the load ceases - no change to PCMMU
Invalid DFL ID	None	Processing of the load ceases - no change to PDI
SM common buffer busy	TFL - TFL FAIL DFL - None	Processing of the load ceases - no change to PDI/PCMMU
OPS transition during load attempt	TFL - TFL FAIL DFL - None	No change to PDI/PCMMU
I/O ERROR on PCMMU/PDI/MMU during load attempt	TFL - TFL FAIL DFL - Applicable decom format ID changed to zero	Zeroes out applicable PDI decom FMI ID for DFL load attempt
SPEC 62 terminated during load attempt	TFL - None DFL - None	TFL load attempt - successful completion. DFL load attempt - new DFL not loaded, no change to decom
Attempt to load PDI decom with no format ID entered, invalid format ID, invalid decom number, or invalid switch matrix input	None	Load attempt aborted. No change to PDI



When any transaction involving the SM common buffer is being processed (such as an SM GPC checkpoint or TFLs and DFLs), another parameter is set. This parameter is called SM COMM BUFF BUSY. Do not initiate any TFL or DFL OP code uplinks while this parameter indicates that the SM common buffer is busy. Any attempt at uplinking a TFL or DFL while the SM common buffer is busy will be rejected.

Note that if the SM machine is re-IPL'd after loading a PDI DFL, the PDI decom formats on SM SPEC 62 will be blank. The SM downlist will show all zeros, even though valid formats are currently loaded in the PDI.

If an OPS transition is initiated while a TFL load is in progress, the load will fail. If it fails, reload the TFL following termination of the OPS transition.

TFLs and DFLs loaded prelaunch via a GNC OPS G9 GPC will not show on SM SPEC 62 when the SM GPCs are brought up, even though the TFLs and DFLs have been loaded.

When PCMMU or PDI is power-cycled, the soft formats are erased in the devices, but SM SPEC 62 still shows the last loaded values.

An example of a TFL/DFL display is shown in Figure 3.9-2.

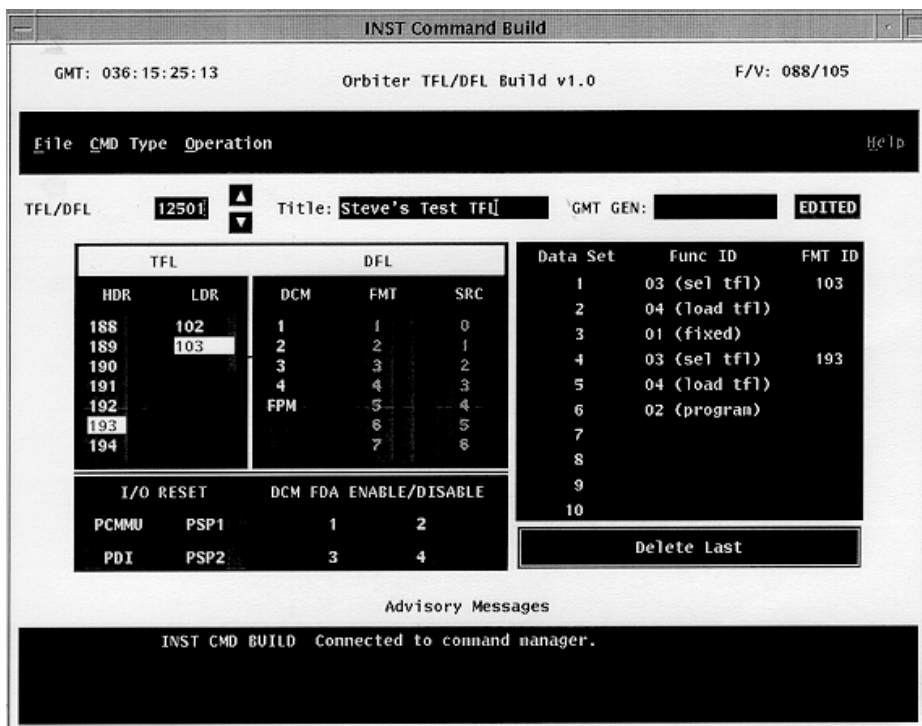


Figure 3.9-2. Example of TFL/DFL display

## TITLE

CREW ALERT

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

## PURPOSE

To summarize how the crew alert commands work in relation to other class 3 alerts and to document the procedures for their use.

## RESTRICTIONS & CONSTRAINTS

This procedure is only valid in all ops modes of the SM major function. If a crew alert ON command is activated and the crew uses a master alarm reset PBI to turn off the tone, the next software driven alert will drive only a CRT message (no tone and the light stays on) and could easily be missed. Therefore, to guard against this possibility, always include the crew alert OFF command(s) in the multiple stored program command (MSPC) load. Because the tone remains on until reset (i.e., timer is not activated), 90 seconds between the ON and OFF commands is sufficient

## GENERAL

When the crew alerts A and B ON commands are sent, two discrettes are set high in both MDM's PF1 (for crew alert A) and PF2 (for crew alert B). One discrete activates the SM alert tone and the other activates the alert light on panel F7. There are several ways to turn off the light and tone.

- A. Crew depresses the ACKNOWLEDGE key on a keyboard. This key is usually used to stop a flashing message line from flashing. However, there is no associated message for crew alert.
- B. Crew depresses the MESSAGE RESET key on a keyboard. This key is usually used to clear a message line.
- C. MCC commands crew alert A (for PF1) and B (for PF2) OFF.

Each of these methods resets both bits in both MDM's.

A fourth option is to reset only the tone by using any of the four master alarm reset PBI's. However, because this reset is a hardware reset to the tone generator circuitry, the two MDM bits are not reset and the SM alert light remains on. Because the bits remain latched, the next (software-driven) SM alert will not result in an aural or visual indication to the crew and could easily be missed; however, they will still get a message. Software-driven SM alerts also activate a timer associated with the tone. When the timer times-out (set by the crew to a maximum of 99 seconds), the MDM tone bits (not the light bits) are reset, and all future tones should work as expected. Crew Alert commands may be sent to any major function that has control of the payload buses. These CMD's should be managed carefully to avoid unnecessarily disturbing crew sleep.

Flight Rule A11.1.1-14 provides rationale for the use of the crew alert SPC's. The Pre-Sleep Audio config in the ORB OPS C/L contains a note to the crew for actions to take if a crew alert alarm has timed out.

## PROCEDURE

- A. Before crew sleep, select a time approximately halfway through the crew sleep period. The time chosen should allow for an opportunity to clear the MSPC on both TDR satellites.
- B. Build and uplink the MSPC to time out per A. The MSPC will contain the following commands.  
  
DSM 4984 CREW ALERT A ON  
DSM 4986 CREW ALERT B ON  
(90 seconds later)  
  
DSM 4985 CREW ALERT A OFF  
DSM 4987 CREW ALERT B OFF
- C. While allowing a backup command opportunity, clear the MSPC prior to its time out.
- D. After the MSPC has been cleared, DO NOT uplink another. ONLY ONE CREW ALERT PER SLEEP SHIFT IS REQUIRED.
- E. If the SPC buffer must be cleared early, REUPLINK THE SAME CREW ALERT MSPC. The crew alert MSPC should be built as an individual DSM so that it can be easily reuplinked.

**TITLE**

GENERIC COMMAND SYSTEM: TIME EXECUTE COMMAND: BUILD PROCEDURE

**CAUTION**

These procedures are governed by FCOH procedure 3.1 and are not to be changed in real time without review and approval of the Flight Director or changed premission without review and approval at the FOIG.

**PURPOSE**

To define a standard set of procedures for building time execute commands (TECs), and maintaining the contents of the onboard TEC storage area (TEC buffer).

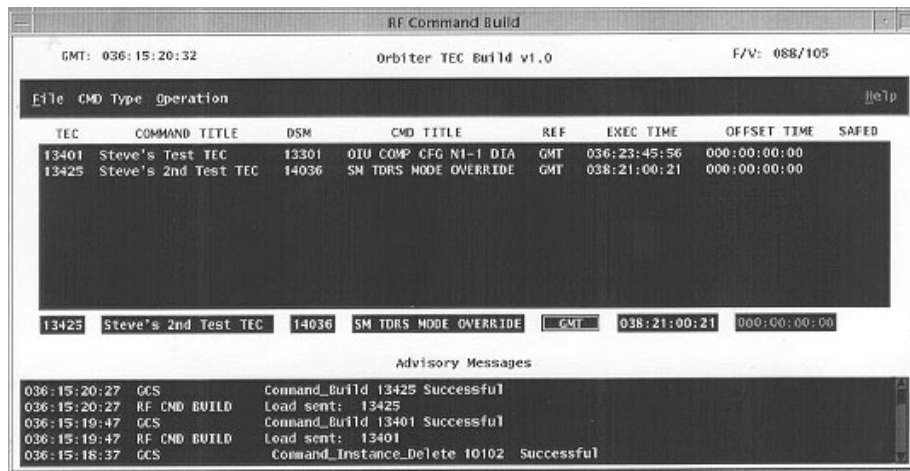
**RESTRICTIONS & CONSTRAINTS**

These procedures are only valid in ops modes 2 and 4 of the SM major function. There are no special restrictions on execution of these procedures.

**GENERAL**

The RF CMD BUILD display is used to create, modify, and delete TECs in the generic command server (GCS). TECs are used to configure the antenna management software in the SM GPC and transfer command data from the SM GPC (using a serial input/output (SIO) MDM channel) either to a PSP or to a payload connected directly to the SIO port when the command's accompanying time of execution expires.

The TEC function is resident only in SM OPS 2 or 4, never in the GNC major function. A TEC can contain command data or antenna management configuration changes for only one function at a time. Several TECs can be chained together to send a set of command data or antenna management configuration changes more simply.



Example of the TEC build display

**PROCEDURE**

A. To build TEC command loads using RF CMD BUILD Display

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the TEC option from the Command Types menu	
2	COMM SPT	Enter a valid DSM number (13401 - 13450), along with a title (such as "S-band East Prime - TEC" etc.) The title can be any character string up to 21 characters long	
3	COMM SPT	If the DSM selected is an existing command load in the server, then data will have to be replaced by typing over the existing information	
4	COMM SPT	Enter the command DSM no. to be contained in the TEC. Select the time execution type (GMT/PET1/PET2), then enter an execution time or offset time	The data will be entered in the type in boxes at the bottom of the display
5	COMM SPT	From the Operations menu at the top of the display select the "Submit" option	The TEC will appear in the upper section of the display with any other TECs that have been saved to the GCS
6	COMM SPT	If there was a command already built with the DSM selected, then a box will pop up asking the user to overwrite the existing command load. Press Yes to replace the command in the server	
7	INCO	Verify the command was built correctly by checking the DSM of the command contained in the TEC and the execution time of the TEC	

B. For TEC transmission, use the procedure in SCP 3.1 for two-stage loads. After uplink, verify the correct number of TECs are in the buffer (INCO MANAGEMENT or COMM MGMT display). The onboard command buffers display should show the uplinked TECs and their execution times.

C. To Save TEC command loads to the workstation

<b>SEQ</b>	<b>Initiator</b>	<b>Action</b>	<b>Comments</b>
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the TEC option from the Command Types menu	
2	COMM SPT	Select the TEC to be saved by “double-clicking” on the DSM no. in the middle of the display or enter the data for the TEC in the type in boxes at the bottom of the display	
3	COMM SPT	Select the “Save” option from the File menu	
4	COMM SPT	Select the directory to save the TEC into from the file selection display or use the default directory displayed	
5	COMM SPT	Type in the filename for the TEC and press the OK button to save the TEC to a file on the workstation	

**TITLE**

CONTINGENCY RTC'S FOR EECOM/THERMAL

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

In the event of a switch failure and the SM or BFS fails, EECOM may request the uplink of certain RTC's through the payload buses. These RTC's control H<sub>2</sub>O loop pumps, freon loop pumps, ammonia boiler, and the flash evaporator system (FES).

**RESTRICTIONS & CONSTRAINTS**

These procedures are only valid in all ops modes of the GNC, SM and the BFS major functions. Coordination with EECOM is required. The crew must have panel switches in the GPC position.

**GENERAL**

The list of the RTC's that are loaded and **safed** in the Command Server are as follows:

Safe group number	Title	DSM
3	H2O 1 PMP A ON	5411
	H2O 1 PMP A OFF	5412
	H2O 1 PMP B ON	5413
	H2O 1 PMP B OFF	5414
	H2O 2 PMP ON	5415
	H2O 2 PMP OFF	5416
3	FES PRI B ON	9100
	FES PRI B OFF	9101
	FES SEC ON	9102
	FES SEC OFF	9103
4	FES PRI A ON	9104
	FES PRI A OFF	9105
	NH3 PRI A/B ON GPC A	9106
	NH3 PRI A/B OFF GPC A	9107
	NH3 PRI A/B ON GPC B	9108
	NH3 PRI A/B OFF GPC B	9109
	NH3 PRI A/B ON GPC C	9110
	NH3 PRI A/B OFF GPC C	9111
*	FCL 1 PMP B ON	9112
	FCL 1 PMP B OFF	9113
	FCL 2 PMP B ON	9114
	FCL 2 PMP B OFF	9115

\* These commands are safed individually, not in a group.

**Figure Error! No text of specified style in document.-1. EECOM RTC 's**

## PROCEDURE

- A. EECOM contacts INCO on the INCO loop with the request for a command uplink. EECOM will provide the following information:
  - 1. DSM number
  - 2. Major Mode (most likely GNC)
  - 3. Verification of Flight Director permission to uplink
- B. INCO informs COMMAND, on the COMMAND loop, to enable the group and/or unsafe the individual RTC per step A and the RTC chart in figure 3.13-1.
- C. INCO transmits the RTC's to the requested major mode.
- D. INCO confirms with EECOM that the command(s) have been transmitted successfully.
- E. INCO resafes/disables the command/group, once EECOM has verified that the commands were executed to their satisfaction.



**TITLE**

GENERIC COMMAND SYSTEM: SPARE RTC BUILD

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

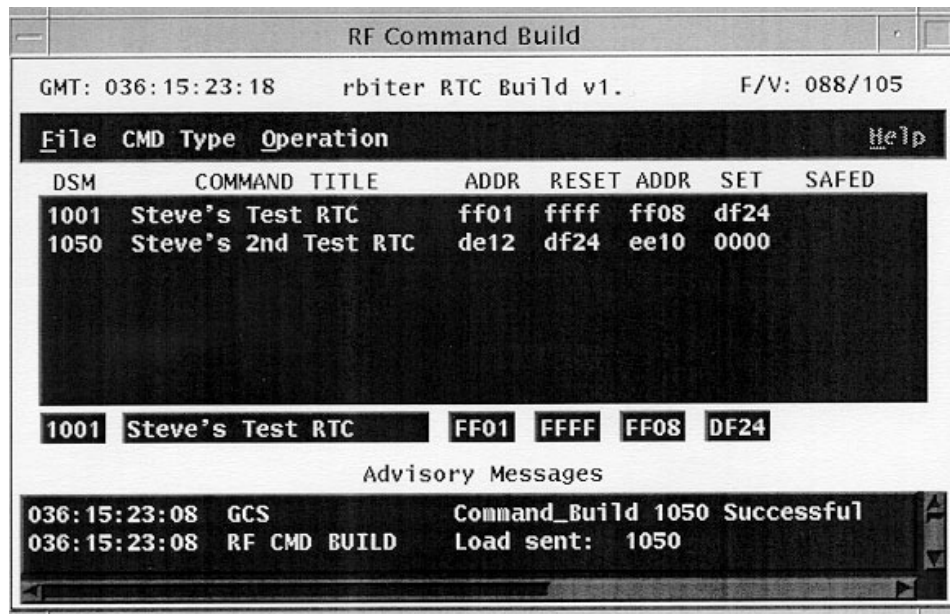
The following outline describes the use of the RF CMD BUILD display to build spare (real-time buildable) RTCs.

**RESTRICTIONS & CONSTRAINTS**

These procedures are valid in all ops modes of the GNC, SM and BFS major functions. There are no special restrictions on execution of these procedures.

**GENERAL**

The RF CMD BUILD display is used to create, modify and delete spare RTCs in the Generic Command Server (GCS). Spare RTCs are used when a real-time command to some orbiter or payload system has not been built previously for the flight. This option is very seldom used (other than for SSR) and must be used with great care because any RTC can be built with this tool. Use SCP 3.30 to build positional RTC's for SSR.



*Figure 3.14-1. Example of RTC Build display*

**PROCEDURE**

A. To build a spare RTC using the RF CMD BUILD display (see Figure 3.14-1)

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the RTC option from the Command Types menu	See SCP 5.143 for details on the description of the RF CMD BUILD display
2	COMM SPT	Enter a valid DSM number (1000-1099), along with a title (such as "Spare RTC for Payloads," etc.). The title can be any character string up to 21 characters long	
3	COMM SPT	If the DSM selected is an existing command load in the server, data will have to be replaced by typing over the existing information	
4	COMM SPT	Enter the MDM address, the reset bit mask, the MDM address, and the set bit mask in HEX characters	The display is smart enough to prevent a bad MDM address from being entered but any reset and set bit masks are excepted
5	COMM SPT	From the Operations menu at the top of the display, select the "Submit" option	The RTC will appear in the upper section of the display with any other RTCs that have been saved to the GCS
6	COMM SPT	If there was a command already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press Yes to replace the command in the server	
7	INCO	Verify the command was built correctly by checking the command data words of the RTC	

Note: ONLY approved Mission Action Request (MARS) or MAST II verified data may be entered for the reset and set bit mask HEX characters.

**TITLE**

MSPC/SPC/MRTC BUILD

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

**PURPOSE**

The following outline describes the use of the RF CMD BUILD display to build, modify, and delete MRTC's, SPC's, and MSPC's. It also illustrates the use of the display to input PET 1 and 2 reference times.

**RESTRICTIONS & CONSTRAINTS**

This procedure is valid for all ops modes of the GNC, SM and BFS major functions.

**GENERAL**

The RF CMD BUILD display is used to create, modify, and delete MSPC's, SPC's, and MRTC's in the Generic Command Server (GCS). MSPC's and SPC's are used to store RTC's onboard in the SM or BFS major functions for execution at some later time. MRTC's are used to contain several RTC's that will be executed onboard as a group, instead of individually uplinking the RTC's.

**PROCEDURE**

- A. To set the Phased Elapsed Time (PET) 1 and 2 with the RF CMD BUILD display (see Figure 3-15-1)

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the PET SET option from the Operations menu	See SCP 5.143 for details on the description of the RF CMD BUILD display
2	COMM SPT	Enter a valid time reference for PET 1, PET 2, or both in GMT. The format should be DDD:HH:MM:SS	Generally, INCO only uses PET 1 and that is set to the expected lift-off time
3	COMM SPT	Press the "Submit" button on the display	Messages will be displayed in the bottom section of the main display, but there is no indication on the PET SET display that the times have been accepted

The image shows a control panel window titled "SET PETS". At the top left is a close button with an "X" icon. Below the title bar is a text field containing "PET Set". The panel is divided into two main columns. The left column contains a "Submit" button at the top, followed by two buttons labeled "PET 1" and "PET 2". The right column contains a "Launch GMT" button at the top, followed by two digital time displays. The top display shows "035:10:20:30" and the bottom display shows "000:00:00:00".

Label	Value
Submit	
PET 1	
PET 2	
Launch GMT	
	035:10:20:30
	000:00:00:00

Figure 3.15-. Example of the SET PETs displayB. To build MSPC command loads using RF CMD BUILD Display (see Figure 3.15-2)

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the MSPC option from the Command Types menu	
2	COMM SPT	Enter a valid DSM number (12101-12150), along with a title (such as Ku Forward or H/O to DGS Rev 24). The title can be any character string up to 21 characters long	The Edited light will turn on with a green background
3	COMM SPT	If the DSM selected is an existing command load in the server, the Clear option from the File menu must be used to clear the contents of the command before continuing. Repeat step 2	
4	COMM SPT	Enter the RTC DSM numbers of the commands to be contained in the MSPC	The titles of the RTCs will appear in the title box next to the DSM numbers
5	COMM SPT	Enter the MDM number for each RTC. Default is 1	
6	COMM SPT	Select the time reference to enter GMT, PET1, or PET2 by pressing the button at the top of the time reference column	All RTCs in the MSPC will use the same time reference. If PET1 or PET2 is used, the Offset time column will be active for entering the times, but if GMT is used, the Execution column will be active
7	COMM SPT	Once the contents of the MSPC are completed, press the Submit button from the Operations menu	Messages appear at the bottom of the display to tell the user the command server has accepted the command. The green Edited light will disappear
8	COMM SPT	If there was a MSPC already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press Yes to replace the command in the server	
9	INCO	Call up the MSPC part of the RF CMD BUILD display to verify that the MSPC was built by COMM SPT	

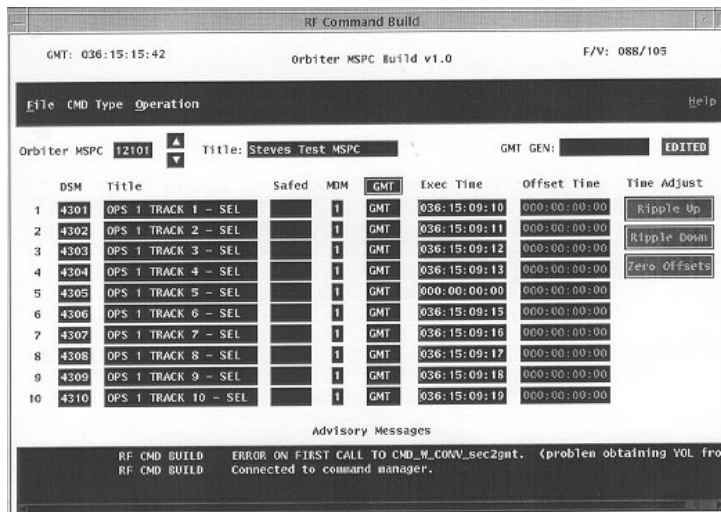
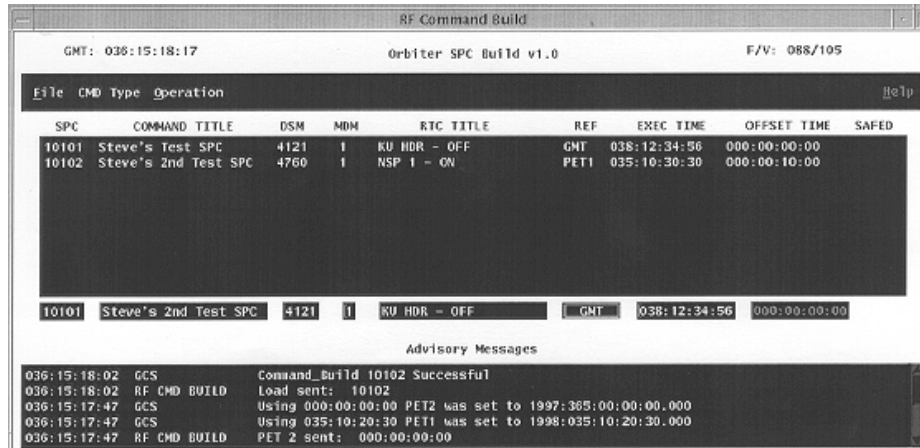


Figure 3.15-2 Example of MSPC BUILD display

C. To build an SPC from the RF CMD BUILD display (see Figure 3.15-3)

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the SPC option from the Command Types menu	
2	COMM SPT	Enter a valid DSM number (10101-12050), and a title (such as FM 1 ON - SPC). The title can be any character string up to 21 characters long	
3	COMM SPT	If the DSM selected is an existing command load in the server, data will have to be replaced by typing over the existing information	
4	COMM SPT	Enter the command to be contained in the SPC. Select the time reference type (GMT/PET1/PET2), enter an execution time or offset time	The data will be entered in the type in boxes at the bottom of the display
5	COMM SPT	From the Operations menu at the top of the display, select the Submit option	The SPC will appear in the upper section of the display with any other SPCs that have been saved to the GCS
6	COMM SPT	If there was a command already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press Yes to replace the command in the server	

SEQ	Initiator	Action	Comments
7	INCO	Verify that the command was built correctly by checking the DSM of the command contained in the SPC and the execution time of the SPC	



**Figure 3.15-3. Example of the SPC BUILD display**

D. To build an MRTC from the RF CMD BUILD display (see Figure 3.154)

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the MRTC option from the Command Types menu	
2	COMM SPT	Enter a valid DSM number (1500 - 1550), along with a title (such as Ku Forward or H/O to DGS Rev 24). The title can be any character string up to 21 characters long	
3	COMM SPT	If the DSM selected is an existing command load in the server, the Clear option from the File menu must be used to clear the contents of the command before continuing. Repeat step 2	The Edited light will turn on with a green background
4	COMM SPT	Enter the RTC DSM numbers of the commands to be contained in the MRTC	The titles of the RTCs will appear in the title box next to the DSM numbers

SEQ	Initiator	Action	Comments
5	COMM SPT	Once the contents of the MRTC are completed, press the Submit button from the Operations menu	Messages will appear at the bottom of the display to tell the user that the command server has accepted the command. The green Edited light will disappear
6	COMM SPT	If there was an MRTC already built with the DSM selected, a box will pop up asking the user to overwrite the existing command load. Press Yes to replace the command in the server	
7	INCO	Call up the MRTC part of the RF CMD BUILD display to verify that the MRTC was built by COMM SPT	

Note: MRTCs can be built that contain safed RTCs. If this is done, both the RTC and the MRTC will have to be unsafed before the MRTC can be uplinked.

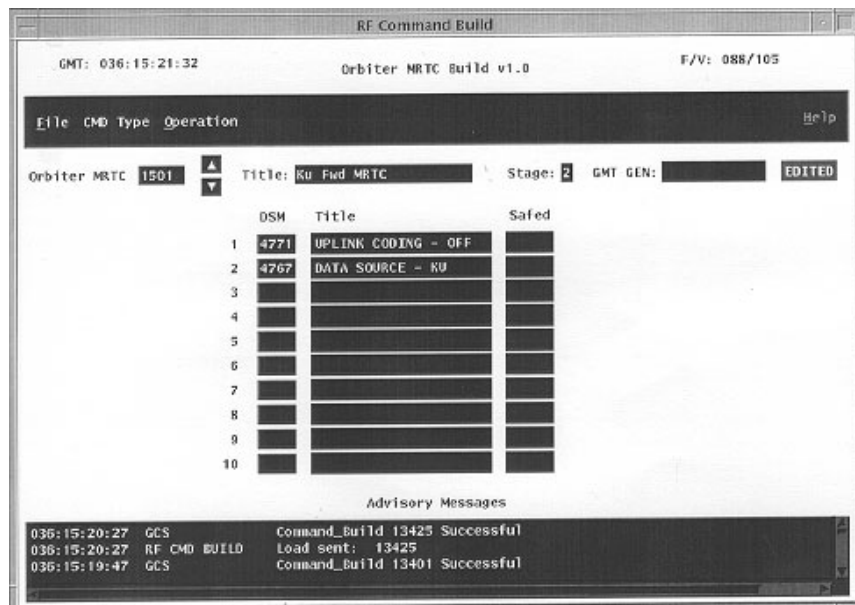


Figure 3.15-4. Example of the MRTC BUILD display



E. To modify an MPS/SPC/MRTC in the command server

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the command type of the command to be modified from the Command Types menu	
2	COMM SPT	Enter the DSM number	The command will appear on the display
3	COMM SPT	Edit the command data as necessary: RTC DSMs, MDM selections, or times	
4	COMM SPT	Press the Submit button from the Operations menu, then press the Yes button when the message box asks if you want to overwrite the command that is already in the server	The green Edited light will disappear
5	INCO	INCO should verify all changes to MSPCs, SPCs, and MRTC by viewing the commands on the RF CMD BUILD display	

Note: If an RTC DSM number is changed in an MSPC, be careful to enter a new offset or execution time because the previous time will be “zeroed out” when a new RTC is selected for that row.

F. To delete an MSPC/SPC/MRTC from the command server

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the command type of the command to be modified from the Command Types menu	
2	COMM SPT	Enter the DSM number	The command will appear on the display
3	COMM SPT	Press the Delete button from the Operations menu	The Operations menu can be “torn off” and put to the side, allowing the operator to delete multiple commands by pressing the Delete button as the commands appear on the display

G. To save commands to a workstation file

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the command type of the command to be modified from the Command Types menu	
2	COMM SPT	Enter all the command data to be saved to a file or enter the DSM of a command that already is in the command server	
3	COMM SPT	From the Files menu select the Save option	Another display will pop up with a list of currently saved files of that command type
4	COMM SPT	Enter a filename for the new workstation file. The filename should not contain any blank characters. The structure of the filename should be as follows:  CMD TITLE - CMD TYPE  Example: Ku_FWD_-_MSPC.	The file will be saved to the workstation for use next time

H. To recall command files from the workstation

SEQ	Initiator	Action	Comments
1	COMM SPT	Call up the RF CMD BUILD display from the INCO GCS DNAV menu and select the command type of the command to be modified from the Command Types menu	
2	COMM SPT	From the Files menu, select the Recall option	Another display will pop up with a list of currently saved files of that command type
3	COMM SPT	Select the filename to be loaded into the display	If the file contains data that will not work on the command type displayed, a message will be displayed at the bottom of the screen
4	COMM SPT	Follow the procedure for modifying the command data	

## TITLE

GENERIC COMMAND SYSTEM: TABLE MAINTENANCE BLOCK UPLINK (TMBU) PROCEDURE

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed premission without review and approval at the FOIG.

## PURPOSE

To define a standard set of procedures for performing updates/changes to the Backup Flight System (BFS) and primary Systems Management (SM) Fault Detection and Annunciation (FDA) limits and constants and special processing constants utilizing the Table Maintenance Block Uplink (TMBU) application in the Generic Command System (GCS).

## RESTRICTIONS & CONSTRAINTS

These procedures are only valid in all ops modes of the SM and the BFS major functions. Do not attempt uplink of TMBU loads while crew has SPEC 60 called up because the TMBU will be rejected.

## GENERAL

Updates or changes to the SM FDA limits, constants, and special processing constants are generally accomplished by ground command. It is the responsibility of individual flight controllers to build their own TMBUs, load them into the server, obtain approval from the Flight Director to uplink them, and then coordinate the uplink with Instrumentation on the INST COORD loop. INCO/COMM SUPPORT is responsible for building and initiating changes that affect communication system parameters or communication software programs/sequences. TMBU loads are supported in both the BFS and primary SM software. A workstation program titled TMBU is provided by DPS to help build and load TMBUs. For building TMBUs during a flight, refer to FCOH (prebuilt TMBUs do not apply). The following procedure covers the general actions that are involved in building a TMBU and loading it into the command server using the TMBU workstation program.

## PROCEDURE

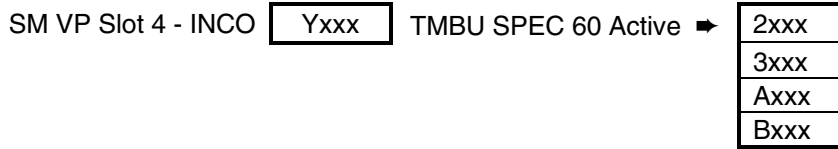
A. Table maintenance block uplink - BUILD from TMBU program (SM or BFS)

The following types of information are needed when using the TMBU program:

1. The Measurement Stimulation Identification Number (MSID) associated with the value/limit to change.
2. The new value for the MSID: The new value input is a decimal number in Engineering Units (EUs) that defines the value of the updated parameter. The initial value for parameters is found in the Reference Data book and in Table 3.16-1.

SEQ	Initiator	Action	Comments
1	COMM SPT or INST	Call up the TMBU display from MASTER DNAV, GLOBAL APPS/COMMAND SERVER/TMBU	
2	COMM SPT or INST	Enter a valid DSM number (12346-12350) with a title (such as NODE Protect Box). The title can be any character string up to 21 characters long	INCO has agreed to only use DSMs 12346 through 12350. The agreement is documented in the FCOH
3	COMM SPT or INST	Type the MSID into the MSID type-in box in the middle of the display, then press the return key	Another display will appear on the screen. MSID is used instead of parameter ID for this display
4	COMM SPT or INST	The popup display may have several options. See the next several substeps for each possible option. Some of the options may be input at the same time so that the TMBU will contain several different changes to the same MSID	
5		<b>Enable/Inhibit Fault Messages</b> - Select the ENA or INH button located in the lower right-hand side of the popup display, then repress the OK button. Example: Antenna Message inhibit	
6		<b>Lower/Upper limit changes</b> - Type in the new upper or lower limit for the set to be changed, then press the OK button. Both the upper and lower limits can be set in the same command load. Example: PA 1 temp change	
7		<b>Constant change</b> - Type in the new constant value for the MSID, then press the OK button. Example: Ku-band beta angle change	
8	COMM SPT or INST	From the Command menu, select the Send option. If the command DSM number is already in the command server, a display asking if the current command should be overwritten by the new command pops up	
9	COMM SPT or INST	From the Command menu at the top of the display, select the Verify option	
10	COMM SPT or INST	To view the command in the server, use the up or down arrows next to the DSM number box at the middle of the display	

Monitor the SM VPs on the inst management or inco\_management display to determine whether SPEC 60 is active on a CRT or is underneath another display or SPEC on a CRT. Slot 4 of the SM VPs contains the parameter that indicates whether SPEC 60 is active or not. If the value of that first parameter is 2XXX, 3XXX, AXXX, or BXXX, where X is any hex value, then SPEC 60 is active or buried on some CRT. If there is any question about the VP, contact DPS SUPT on the MOCR DPS/CDMS loop.



B. Saving the command to a file on the workstation

While the command is visible in the upper "build" part of the display, select the file Save option from the File menu. The file will be created with a name that includes the DSM number. If there is already a file with the DSM number, the display asks if the filename should be the DSM number with an extension.

Example: 12345.01

C. TMBU - Special process for SM antenna management

The primary SM software provides a special TMBU update capability to the Antenna Management (AM) software. In addition to update capability of the X, Y, and Z position data for each of the 16 sites in the STDN SITE table, the STDN SITE ID may be changed. This change is accomplished by treating each site ID as a constant/character string and is updated as follows in Figure 3.16-1:

Change format for - STDN SITE "N" ID

Bit no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	0	Char. 1 code			Char. 2 code				Char. 3 code						

Character code is defined as follows:

<u>Character</u>	<u>Code</u>	<u>Character</u>	<u>Code</u>	<u>Character</u>	<u>Code</u>
A	00001	J	01010	S	10011
B	00010	K	01011	T	10100
C	00011	L	01100	U	10101
D	00100	M	01101	V	10110
E	00101	N	01110	W	10111
F	00110	O	01111	X	11000
G	00111	P	10000	Y	11001
H	01000	Q	10001	Z	11010
I	01001	R	10010		

Note: Codes 00000 and 11011-11111 are defined as blank.

The 16-bit word above is converted to decimal for input.

Bits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Character	<b>I</b>					<b>O</b>					<b>S</b>					Decimal
Binary value	0	1	0	0	1	0	1	1	1	1	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>	= 9715

Example: MSID V98H5000C - STDN SITE 1 ADS ID (IOS)

**Figure 3.16-1. Change format for STDN SITE 'N' ID**

Table 3.16-1 lists the PASS parameter names, MSIDs, and I-loaded values.

Site configuration values are given Table 3.16-2.

**Table 3.16-1. PASS parameter name, MSID, and I-loaded values reference table**

Parameter name	MSID	Case	UDS	Constant	Lower limit	Upper limit	Noise filter	Msg status
Ku-BD RF Protection Zone 1 Roll 1	V92H0169C			145°				
Ku-BD RF Protection Zone 1 Roll 2	V92H0170C			150°				
Ku-BD RF Protection Zone 1 Pitch 1	V92H0171C			-60°				
Ku-BD RF Protection Zone 1 Pitch 2	V92H0172C			-55°				
Ku-BD RF Protection Zone 2 Roll 1	V92H0887C			150°				
Ku-BD RF Protection Zone 2 Roll 2	V92H0888C			155°				
Ku-BD RF Protection Zone 2 Pitch 1	V92H0889C			-60°				
Ku-BD RF Protection Zone 2 Pitch 2	V92H0890C			-55°				
Ku-BD RF Protection Zone 3 Roll 1	V92H0891C			145°				
Ku-BD RF Protection Zone 3 Roll 2	V92H0892C			150°				
Ku-BD RF Protection Zone 3 Pitch 1	V92H0893C			-65°				
Ku-BD RF Protection Zone 3 Pitch 2	V92H0894C			-60°				
Ku-BD RF Protection Zone 4 Roll 1	V92H0895C			150°				
Ku-BD RF Protection Zone 4 Roll 2	V92H0896C			155°				
Ku-BD RF Protection Zone 4 Pitch 1	V92H0897C			-65°				
Ku-BD RF Protection Zone 4 Pitch 2	V92H0898C			-60°				
S-Band Quad Fwd Beam Select Limit	V92U0960C			0.12187				
S-Band Quad Aft Beam Select Limit	V92U0961C			0.052336				
Ku GPC Acquire Delay Time	V92W1010C			20.0 sec				
Attitude Compensation Delay Time	V92W1013C			0.2 sec				
TDRS Minimum Elevation	V92W1006C			0.0 °				
Site Minimum Elevation	V92W1005C			0.0 °				
Auto Ku To S H/O Minimum AGC	V93V1017C			1.04 VDC				
Auto S-Band to Ku-Band H/O Time	V93W1018C			15 sec				
Auto Ku-Band to S-Band H/O Time	V93W1019C			5 sec				
Ku Beta Angle	V98H5064C			21°				
Ku-Band XMTR Temp	V74T2497A	1			OSL	OSH	15	Enabled
		2			OSL	171°		
Ku-Band A-Gimbal Temp	V74T2965A	1			OSL	OSH	15	Enabled
		2			OSL	150		
Ku-Band Gyro Temp	V74T2967A	1			OSL	OSH	15	Enabled
		2			OSL	155°		
Ku-Band B-Gimbal Temp	V74T2969A	1			OSL	OSH	15	Enabled
		2			OSL	166°		
PA 1 Output Low	V74E4512A				60 w	OSH	15	Enabled
PA 2 Output Low	V74E4513A				60 w	OSH	15	Enabled
PWR AMP 1 TEMP	V74T4514A				OSL	230	15	Enabled
PWR AMP 2 TEMP	V74T4515A				OSL	230	15	Enabled
GCIL ACTIVE	V74X5052E		0				15	Enabled
QUAD ANT VERIF	V92X1049X		1				8	Enabled
OIU Temp limit (PF1 MDM)	P50T4000V				OSL	212°	10	Enabled
OIU Temp Limit (PF 2 MDM)	P50T4001V				OSL	212°	10	Enabled
OIU CONV ERR	P50X4288E						10	Enabled
OIU AD 1 NO LK	P50X4440E	1	2				10	Enabled
		2	1					
OIU AD 2 NO LK	P50X4450E	1	2				10	Enabled
		2	1					
OIU AD 3 NO LK	P50X4460E	1	2				10	Enabled
		2	1					
OIU AD 4 NO LK	P50X4470E	1	2				10	Enabled
		2	1					

Case - Some parameters have more than one possible level of failure detection. These are noted by more than one case.  
UDS - Undesirable state.  
OSL - Offscale low.  
OSH - Offscale high.

Table 3.16-2. Site configuration values

Parameter name	SM			BFS		
	Type	MSID	Initial value	Type	MSID	Initial value
STDN Site 1 ID	17	V98H5000C	13612 (MIL)	253	N/A	(MIL)
STDN Site 1 X LOC	17	V98H5001C	2976090 ft	253	2	2976090
STDN Site 1 Y LOC	17	V98H5002C	-18160085 ft	253	4	-18160085
STDN Site 1 Z LOC	17	V98H5003C	9928196 ft	253	6	9928196
STDN Site 2 ID	17	V98H5004C	14611 (NHS)	253	N/A	(PDL)
STDN Site 2 X LOC.	17	V98H5005C	4834982 ft	253	8	2890910
STDN Site 2 Y LOC.	17	V98H5006C	-14560344 ft	253	10	-18074807
STDN Site 2 Z LOC.	17	V98H5007C	14183518 ft	253	12	10106183
STDN Site 3 ID	17	V98H5008C	16019 (OTS)	253	N/A	(DFR)
STDN Site 3 X LOC.	17	V98H5009C	13161595 ft	253	14	-8032187
STDN Site 3 Y LOC.	17	V98H5010C	-205622 ft	253	16	-15178240
STDN Site 3 Z LOC.	17	V98H5011C	16212284 ft	253	18	11921592
STDN Site 4 ID	17	V98H5012C	4339 (DGS)	253	N/A	(WLP)
STDN Site 4 X LOC.	17	V98H5013C	6287048 ft	253	20	4144984
STDN Site 4 Y LOC.	17	V98H5014C	19783338 ft	253	22	-15998608
STDN Site 4 Z LOC	17	V98H5015C	-2630439 ft	253	24	12792264
STDN Site 5 ID	17	V98H5016C	7827 (GTS)	253	N/A	(JDI)
STDN Site 5 X LOC.	17	V98H5017C	-16633654 ft	253	26	325621
STDN Site 5 Y LOC.	17	V98H5018C	11709733 ft	253	28	-18383145
STDN Site 5 Z LOC.	17	V98H5019C	4894214 ft	253	30	9437432
STDN Site 6 ID	17	V98H5020C	8851 (HTS)	253	N/A	(CTS)
STDN Site 6 X LOC.	17	V98H5021C	-18085622 ft	253	32	-4097347
STDN Site 6 Y LOC.	17	V98H5022C	-7210938 ft	253	34	-15810853
STDN Site 6 Z LOC.	17	V98H5023C	7645063 ft	253	36	13047085
STDN Site 7 ID	17	V98H5024C	23187 (VTS)	253	N/A	(GTS)
STDN Site 7 X LOC.	17	V98H5025C	-8729631 ft	253	38	-16633654
STDN Site 7 Y LOC.	17	V98H5026C	-14816835 ft	253	40	11709733
STDN Site 7 Z LOC.	17	V98H5027C	11883737 ft	253	42	4894214
STDN Site 8 ID	17	V98H5028C	4306 (DFR)	253	N/A	(HTS)
STDN Site 8 X LOC	17	V98H5029C	-8032187 ft	253	44	-18085622
STDN Site 8 Y LOC.	17	V98H5030C	-15178240 ft	253	46	-7210938
STDN Site 8 Z LOC.	17	V98H5031C	11921592 ft	253	48	7645063
STDN Site 9 ID	17	V98H5032C	3731 (CTS)	253	N/A	(VTS)
STDN Site 9 X LOC.	17	V98H5033C	-4097347 ft	253	50	-8729631
STDN Site 9 Y LOC.	17	V98H5034C	-15810853 ft	253	52	-14816835
STDN Site 9 Z LOC.	17	V98H5035C	13047085 ft	253	54	11883737
STDN Site 10 ID	17	V98H5036C	10851 (JSC)	253	N/A	(OTS)
STDN Site 10 X LOC.	17	V98H5037C	1608712 ft	253	56	13161595
STDN Site 10 Y LOC.	17	V98H5038C	-18144482 ft	253	58	-205622
STDN Site 10 Z LOC.	17	V98H5039C	10264751 ft	253	60	16212284
STDN Site 11 ID	17	V98H5040C	13348 (MAD)	253	N/A	(DGS)
STDN Site 11 X LOC.	17	V98H5041C	15909274 ft	253	62	6287048
STDN Site 11 Y LOC.	17	V98H5042C	-1182650 ft	253	64	19783338
STDN Site 11 Z LOC.	17	V98H5043C	13500655 ft	253	66	-2630439
STDN Site 12 ID	17	V98H5044C	7320 (GDX)	253	N/A	(NHS)
STDN Site 12 X LOC.	17	V98H5045C	-7725536 ft	253	68	4834982
STDN Site 12 Y LOC.	17	V98H5046C	-15245317 ft	253	70	-14560344
STDN Site 12 Z LOC.	17	V98H5047C	12038785 ft	253	72	14183518
STDN Site 13 ID	17	V98H5048C	3118 (CAN)	253	N/A	(MAD)
STDN Site 13 X LOC.	17	V98H5049C	-14635284 ft	253	74	15909274
STDN Site 13 Y LOC.	17	V98H5050C	8799650 ft	253	76	-1182650
STDN Site 13 Z LOC.	17	V98H5051C	-12057073 ft	253	78	13500655
STDN Site 14 ID	17	V98H5052C	23952 (WLP)	253	N/A	(GDX)
STDN Site 14 X LOC	17	V98H5053C	4144984 ft	253	80	-7725536
STDN Site 14 Y LOC	17	V98H5054C	-15998608 ft	253	82	-15245317
STDN Site 14 Z LOC	17	V98H5055C	12792264 ft	253	84	12038785
STDN Site 15 ID	17	V98H5056C	0 (blank)	253		(CAN)
STDN Site 15 X LOC	17	V98H5057C	2976090 ft	253	86	-14635284
STDN Site 15 Y LOC	17	V98H5058C	-18160085 ft	253	88	8799650
STDN Site 15 Z LOC	17	V98H5059C	9928196 ft	253	90	-12057073



Parameter name	SM			BFS		
	Type	MSID	Initial value	Type	MSID	Initial value
STDN Site 16 ID	17	V98H5060C	0 (blank)	253		(JSC)
STDN Site 16 X LOC	17	V98H5061C	2976090 ft	253	92	1608712
STDN Site 16 Y LOC	17	V98H5062C	-18160085 ft	253	94	-18144482
STDN Site 16 Z LOC	17	V98H5063C	9928196 ft	253	96	10264751
BFS SITE INHIBIT TMBUs are TBD						
ALL Sites Enabled				253	V96U7799C	0

TMBU VERIFICATION

The TMBU load is a two-stage command load which uplinks a maximum of 10 table maintenance data set changes. However, because of a known problem with the TMBU application (ARs 722384 and 726738), TMBU loads should be limited to nine data set changes when possible. If a TMBU load is generated with 10 data set changes, data corruption will occur on any attempt to edit a data set. If a change is required to a TMBU load containing 10 data sets, you must first delete the data set to be modified and then reenter the data set. Data corruption is unpredictable, but will be presented to the user exactly as it is to be uplinked. The TMBU application is updated concurrently with the Mariner platform release. Until the fix is implemented, an OPS Note is available in EDP on the Flight Specific OPS Notes shelf. Each data set is composed of a type, a parameter ID, and the desired new value. Figure 3.16-3 shows the GCS TMBU application window. The data that are actually uplinked are in the verification window in the lower box of the TMBU form. The data set type is an 8-bit integer field, the parameter ID is a 24-bit integer field, and the new value is a 64-bit double-precision floating-point field. Each data set, therefore, is six 16-bit words.

Table Maintenance Block Update (v 01.02.00)

---

File Command Options Help

Uplink log last updated: 98/286:19:56:29

Flight  Recon  DSM  Title

Rationale

---

MSID  Delete MSID Entry

Nomenclature	MSID	Class	Set	Limit	Type	Param ID	Previous	New
MAIN BUS C CONT BUS BC3/CA3 RP	V76X0326E	3	1	UDS	2	760326	0	0.000000
MAIN BUS C CONT BUS BC3/CA3 RP	V76X0326E	3	0	NF	8	760326	2	1.000000
MAIN BUS C CONT BUS BC3/CA3 RP	V76X0326E	3	0	ENA	9	760326	ENA	1.000000
AC BUS 3 OVERLOAD	V76X1706E	2	1	UDS	11	761706	1	0.000000
AC BUS 3 OVERLOAD	V76X1706E	2	0	NF	13	761706	2	4.000000
AC BUS 3 OVERLOAD	V76X1706E	2	0	INH	15	761706	ENA	1.000000

---

DSM  Title  GMT Gen

Opcode  No. of Datasets  Uplink State

Type	Param ID	New Value
2	760326	0.0000000000
8	760326	1.0000000000
9	760326	1.0000000000
11	761706	0.0000000000
13	761706	4.0000000000
15	761706	1.0000000000

---

Command\_Build 12305 Successful

Figure 3.16-3. GCS Table Maintenance Block Update application

A TMBU load can be sent to the PASS or BFS, but the software designs are different and, consequently, the loads are different.

PASS TMBU VERIFICATION

A. Data set type

The data set type is a two-digit decimal number that defines the update as a constant, an enable/inhibit, a noise filter, or one of eight FDA limit changes (Table 3.16-3).

**Table 3.16-3. PASS data set types**

Parameter	Class	Limit	Type code
Alert limit set 1	3*	Low High	02 03
Alert limit set 2	3*	Low High	04 05
Alert limit set 3	3*	Low High	06 07
Alert noise filter	3*		08
Alert enable	3*		09
Alert inhibit	3*		10
Backup C&W limit	2	Low High	11 12
BU C&W noise filter	2		13
BU C&W enable	2		14
BU C&W inhibit	2		15
Constant	N/A	Constant	17

\*Can also have class 0 or 4 parameters.

B. Parameter ID

In SM OPS 2, the parameter ID is formed from the MSID (MML number) by converting the first alphabetic field to a one-digit decimal number (see Table 3.16-4) and dropping subsequent alphabetic fields.

Example: V45C0100A = 0450100.

**Table 3.16-4. PASS parameter ID conversion**

V	0	Orbiter vehicle
A	1	Ground test article
B	2	SRB
E	3	SSME
F	4	FSE
G	5	GSE
P	6	Payload
T	7	ET
U	8	SSUS (IUS)
L	9	Spacelab

C. New value

The new value is the new desired value of the limit or constant specified. This value must not exceed the software range of that parameter as specified by the calculated off-scale high and low values. PASS parameters with first order (linear) positively sloped cal curves are uplinked in EUs and stored in PCM counts. Nonlinear or negatively sloped cal curve parameters and constants are uplinked and stored in EUs.

Enable/inhibits require a value of 1.0 be entered for the new value. All other dataset types use the desired value specified on the TMBU form.

The calibration curve for each transducer reflects the relationship between the physical measurement (temp, pressure) and the voltage provided to the MDM by the signal conditioner. The MDM generates an integer called PCM count that corresponds to an analog measurement. The conversion of PCM to EU is given by the following equation, where  $A_0$ ,  $A_1$ ,  $A_2$ , and  $A_3$  are the coefficients of the cal curve. Usually, this equation is no more than third order.

$$EU = A_0 + A_1 (PCM) + A_2 (PCM)^2 + A_3 (PCM)^3$$

The cal curve for each transducer and the associated parameters is located in the SM/PM Database Information Listing (DBIL).

BFS TMBU

A. Dataset type

The dataset type indicates in which of seven tables the value of interest is located (see Table 3.16-5).

**Table 3.16-5. BFS data set types**

Data set type	BFS table
255	FDA high limits
254	FDA low limits
253	SM and special processes constants
252	Sequencing constants
251	Payload FDA high-limit set
250	Payload FDA low-limit set
249	Payload constant values
248	Invalid

B. Parameter ID

The parameter ID for a BFS parameter is a decimal number that represents the offset (index) into the appropriate table (array) of limit, constant, or discrete values. The parameter type (integer, scalar, etc.) determines the format of its ID, based upon how many half-words are required to store its limit value in the array. See Table 3.16-6 for these definitions. Specifically, a parameter that occupies one 16-bit half-word has an ID created by decimally adding the array offset to 1114112 (1114112 decimal is equivalent to 110000 hex). The parameter type is apparent from the 11 in the left two places (11XXXX), where XXXX is the array offset. Parameters that occupy a full word (32-bit floating point) are represented by an ID that is the direct array offset (since the offset is implicitly added to 0000000, which can be thought of as the decimal equivalent to 00XXXX hex).

**Table 3.16-6. BFS parameter ID**

Parameter type	No. half-words for array data type	ID hex format	ID decimal format
Single-precision integers	1	110000	1114112 + offset
Double-precision integers	2	000000	Offset
Single-precision scalars	2	000000	Offset
Double-precision scalars	4	000000	Offset
Bit string variables	1 or 2	110000 or 000000	(Either method)
Boolean (1 bit)	1	110000	1114112 + offset

C. New value

- Discretes (1 or 0) are stored as 16-bit integer 1 or 0 value and may be entered into the uplink system as 1 or 0.
- Analog FDA limits (non-payload) are stored in PCM \* 64 format. The GPC left-justifies the 10-bit parameter (9 bits plus sign) in a 16-bit word. This shift-left is accomplished by multiplying the PCM value by 64. Since BFS FDA processing of integers directly converts the uplink double-precision floating-point value to the integer format, the uplinked value must be multiplied by 64 before uplink.

FDA parameters are received from an MDM as 10-bit binary numbers that are left-justified within a 16-bit word. In order to save GPC processing, the values are not right-justified; i.e., divided by 64. Therefore, ground-initiated changes have to be uplinked as PCM x 64.

The following formula, derived from the cal curve equation, is used for linear analog parameters to convert the desired EU value to PCM counts:

$$PCM = \frac{(Desired\ value - A_0)}{A_1 \times 64}$$

The A1 coefficient must also be multiplied by 64. The value of A1 (which is the value that is listed on the fiche) is predivided by 64. When BFS displays a parameter on a CRT, the PCM counts must be converted to EU. Since PCM is stored as PCM x 64, predivision of the A1 coefficients has the effect of dividing PCM by 64. Therefore, the PCM count is adjusted to the correct value without an additional division operation.

This PCM value must be rounded to a whole PCM count before multiplying by 64. This ensures that the remaining 6 bits (least significant) are all zero. The rule for rounding is for an upper limit, round down to the next integer; for a lower limit, round up to the next integer.

Linear analog parameters are set Off-Scale High (OSH) by using  $OSH = +32,704$  PCM counts or Off-Scale Low (OSL) by using  $OSL = -32,768$  PCM counts (see Table 3.16-7).

**Table 3.16-7. BFS off-scale values**

Analog FDA  (Linear and constants)	$OSH = +32,704$ (Stored PCM * 64)	Sign bit $\downarrow$ $2^{14}$ $\boxed{X \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1} = +32,704$ $2^0$ $X = 0 = POS$ SHL 6 bits
	$OSL = -32,768$ (Stored PCM * 64)	Sign bit $\downarrow$ $2^{14}$ $\boxed{X \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0} = -32,768$ $2^0$ $X = 1 = NEG$ SHL 6 bits
PYLD -APP-FUNC * type 251, 250	$OSH = +511$ (Stored PCM)	Sign bit $\downarrow$ $2^8$ $\boxed{0 \ 0 \ 0 \ 0 \ 0 \ 0 \ X \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1} = +511$ $2^0$ $X = 0 = POS$
	$OSL = -512$ (Stored PCM)	Sign bit $\downarrow$ $2^8$ $\boxed{0 \ 0 \ 0 \ 0 \ 0 \ 0 \ X \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0} = -512$ $2^0$ $X = 1 = NEG$

\* Payload analog parameters are 10-bit signed 2's complement, 8-bit signed 2's complement, or 8-bit unsigned.

j\_18819\_205.cvs

- Analog nonlinear parameters are handled the same way as linear parameters, except that the increased complexity of trying to solve a cubic equation for PCM has been done already and the PCM versus EU values are given in tabular form in the back of the DBIL. For a lower limit, select the PCM count value that corresponds to the EU value just above the desired EU value. For an upper limit, select the PCM count value that corresponds to the EU value just below the desired EU value.
- Analog constants are most often stored as single-precision floating-point values and are entered into the uplink system in EUs; some are stored as integers.

D. Payload parameters

BFS software release 09.21 (STS-9) introduced a new module, PYLD\_APP\_FUNC, which performs downlist processing, FDA, and scaling for display for up to 50 payload-dependent parameters. The parameters are restricted to two types, discretized and linear analogs, the limit values of which are contained in either the upper limit table (data type 251) or low limit table (data type 250).

Since only 25 half-words of the BFS downlist are allocated to payloads, this dictates the possible combination of analog and discrete parameters. An analog equals 1 half-word, and 16 discretized equal 1 half-word. Therefore, maximum content could be 50 discretized (although 400 discretized could be packed into 25 H/Ws) or 25 analogs, or some combination thereof that does not exceed 50 parameters (TMBU storage locations) or 25 half-words.

This module differs from other BFS FDA processing. The analog limits are stored in PCM counts (not PCM \* 64) since the 10-bit parameter has already been shifted right 6 bits. The off-scale range, however, is still -512/+511 PCM counts.

1. Payload parameters that are processed by PYLD\_APP\_FUNC are already shifted right and are stored in PCM counts (not PCM \* 64). Therefore, it is not necessary to multiply the rounded PCM value by 64 before uplink. The new value for uplink is calculated using the following equation.

$$\text{PCM} = \frac{(\text{Desired value} - A_0)}{A_1}$$

2. The A1 coefficient is not predivided by 64; therefore, multiplication by 64 is not required. The same rounding technique (used for non-payload parameters) is used, and the whole PCM value is then uplinked.
3. The cal curve for each transducer and the associated parameters is located in the BFS Database Listing. In most cases, these cal curves are identical to the identical parameter in PASS.

**TITLE**

GENERIC COMMAND SYSTEM: USE OF THE GENERIC COMMAND BUILD TOOL

**PURPOSE**

Provides the capability to build or modify any two-stage load. The generic command load is a variable length load.

**GENERAL**

The generic commands are loaded in the command server and safed at the time of generation. Figure 3.18-1 shows the command restrictions/constraints for this capability.

**COMMAND RESTRICTIONS/CONSTRAINTS**

CMD CR# Baseline

DATE: 11/12/87

1. Hazard/safety implication (should/are safed?): Are safed
2. Valid software major modes (if applicable, include OPS mode X01, X02...): All

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC	X									
SM	X									
BFS	X									
PL										
OPS 0										

3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: None

**FIGURE 3.18-1. COMMAND RESTRICTIONS/CONSTRAINTS**

**PROCEDURE**

SEQ	Initiator	Action	Comments
1	INCO	Request approval from the Flight Director to build a generic command load	
2	COMM SPT or INST	Request that Command enable generic command for the workstation and op code needed. Example: "Command, enable white-mpsr10 for generic command with Op Code OA"	Command will need to type in the complete workstation name to enable access to build generic commands



SEQ	Initiator	Action	Comments
3	COMM SPT or INST	Build the command by selecting the DSM number, title, and command data words	The command will be stored in the server as Safed
4	INCO	Request a GO from the Flight Director for uplinking the command	
5	COMM SPT or INST	Request Command to unsafe the DSM number for the command	The command will show up as unsafed on the command inventory display
6	INCO	Uplink the command per FCOH SOPs 3.1 and 3.2.3	
7	COMM SPT or INST	Request that command disable generic commanding for the workstation used to build the load and safe the DSM number of the command load	

**BASIC DISPLAY**

- A. DSM number - Load class defaults to 199. Load sequence is a decimal integer 01-50. The allocation of generic command DSM numbers is as follows:
  - 19901 - 19915    DPS
  - 19916 - 19920    Spare
  - 19921 - 19925    GNC
  - 19926 - 19940    RMS
  - 19941 - 19950    Spare
- B. TITLE - 21-character maximum. Default title is Generic Command Load.
- C. OPTION - Default to manual generation. Only the title and uplink data words may be changed with the modify option.
- D. OP CODE - The minimum/maximum range is 01-7E hexadecimal. The OP code should be validated against the valid two-stage OP codes in the OP Code Control Status Table display.
- E. MF - MF = 0 indicates that the major function will be determined by the console configuration at the time of uplink.
- F. UPWD HEX 02-67 - Uplink data words 02 through 03 are the minimum required input data words. Each uplink data word provided shall be four hexadecimal characters. The total number of 48-bit words in a generic command load cannot be increased or reduced by the modify option.

## TITLE

GENERIC COMMAND SYSTEM: COMMAND APPLICATION INITIALIZATION

## PURPOSE

To define the procedures used to initialize the command applications and the interface to the space shuttle Generic Command System (GCS) from the MCC workstations.

## GENERAL

These procedures are used to initialize the interface to the GCS from the MCC workstations. There are four procedures included in this SCP. The first one is a step-by-step sequence to register a workstation as a command user with the GCS. The second sequence starts the hardware panel. The third starts the point-and-click command displays. The last sequence terminates the command interface to the GCS.

### To Register as a Command User

1. Select INCO display navigation menu.
2. Start GCS/Start Command Manager First. A small display will pop up on the screen (figure 3.19-1) that indicates the status of the interface between the workstation and the command server.



Figure 3.19-1

3. A display will pop up in the middle of the screen for requesting a link between the workstation and the shuttle (SSP) or station (ISS) command server (figure 3.19-2).
4. Select the SSP command server by pressing the left mouse button while the mouse cursor is located over the SSP line in the display (figure 3.19-2). Press the Submit button to complete the selection.

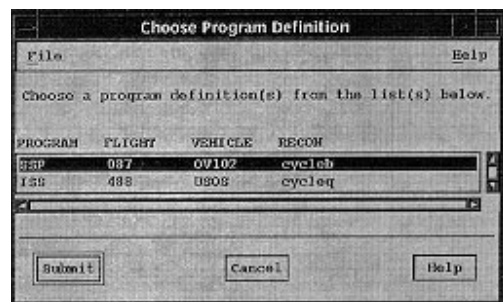


Figure 3.19-2

5. Shortly after the command manager status display is started, another display will pop up on the screen. This is the Kerberos access display (figure 3.19-3). The access code must be typed into this display, then press the "Enter" key. If the correct access code is entered, the command manager display will change to green and indicate that the interface is active. The access codes can be obtained from the lead INCO group administrator (GA). There will be access codes for each flight and for test/simulation mode activities, so a new access code will have to be created for each flight. The flight controllers will need to know the code. Because this code is NOT a password, the normal computer security rules do not apply to the Kerberos access codes.



Figure 3.19-3

If an invalid access code is entered, the Kerberos display will replace the "enter access code" message located just above the type-in box with an error message. Simply type in the correct access code to get past this step. There will be no indication that the correct access code was entered, except that the Kerberos display will disappear, and the little command manager display will turn green.

- Once the correct Kerberos access code is entered, a display will pop up that is used to select a position (figure 3.19-4). There are six possible positions for the INCO group. The standard Workstation/Positions are listed in the table below. Each position can be used on up to four workstations, but only one user ID can be attached to the position. This means that the person using the INCO workstations can select INCO as the position on both of them, as long as the same user ID was used to log on to both INCO workstations. There will be two extra positions added to the available position list. These will be for those users who need access to the displays, but are not the primary operators.

<u>Workstation</u>		<u>Position</u>
WF 5/24	→	INCO
WM 10	→	Datacomm
WM 13	→	RF Comm
WM 5	→	INST
extra	→	INCO01
extra	→	INCO02

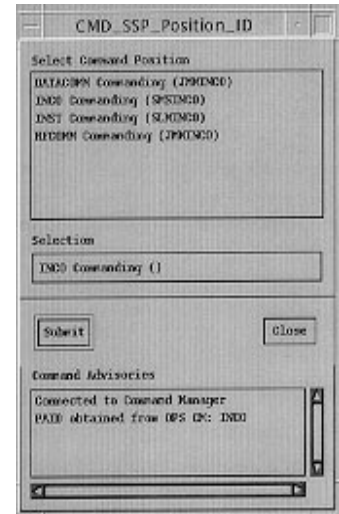


Figure 3.19-4

- Contact the COMMAND flight control position on the COMMAND loop to have the Position selected enabled. Once COMMAND reports back that the position is enabled, this procedure is completed. The display to verify the enable/disable status is located on the INCO DNAV GCS/Other Command Displays/Position Status.”

#### To Start the Hardware Command Panel

- From the INCO display navigation menu, select either the GCS/H/W CMD PANEL - Orbit or H/W CMD PANEL - Ascent option. The hardware panel user interface will start, and the NASA “meatball” will appear on the panel buttons.

#### NOTE

The INCO console has two workstations on it. The hardware panel can be started only from the workstation named white-fcr 5. Attempting to start the hardware panel from white-fcr24 will not be successful.

- After the NASA “meatball” appears, press any PBI on the panel to continue.
- Press the enable button on the CMD\_W\_pbimgr window.
- Continue with nominal operations.

#### To Start the Software Command Panel (point and click)

- From the INCO display navigation menu, select either the GCS/S/W CMD PANEL - Orbit or S/W CMD PANEL - Ascent option.
- The display will appear on the screen (figure 3.19 - 5). See SCP 5.140 for an explanation of the display.
- Continue with nominal operations.

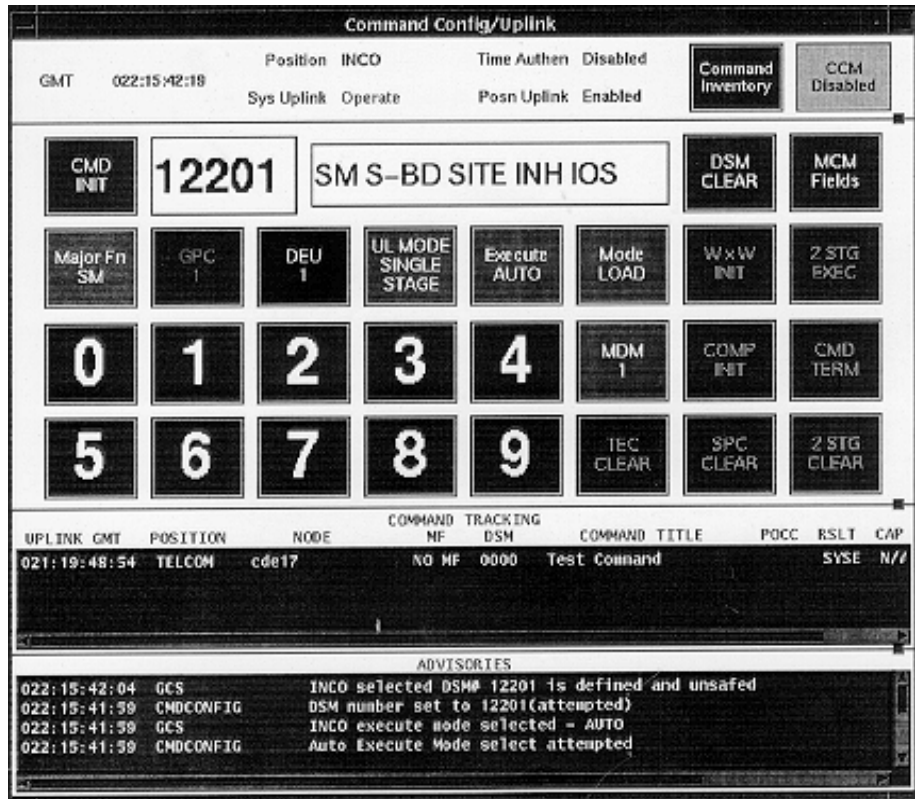


Figure 3.19-5

### To Shut Down the Command Manager

1. Close all command displays.
2. From the INCO Dnav, select GCS/KILL COMMAND MANAGER DEAD. The command manager status display will change to red and indicate that the command manager interface to the command server is closing. Once the command manager display has disappeared from the screen, the interface to the command server is closed.

TITLE

COMMAND SAFING PROCEDURES

CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to change in real time without review and approval of the Flight Director or be changed premission without review and approval at the FOIG.

PURPOSE

To document command safing procedures including rationale.

GENERAL

Following the unintentional uplink of ops recorder commands on STS-69, the MOD Safety Board recommended setting up a process to determine if commands should be protected from unintentional uplink by safing them in the command server. The criteria that are used to assess whether commands should be safed are as follows: Commands that pose a safety risk to the orbiter, its payloads, or its crew if unintentionally uplinked should require unsafing to accomplish uplink during the susceptibility window.

PROCEDURE

- A. The following commands should be verified safed in the command server during prelaunch.
  1. Ku-band beta angle commands
    - a. DSM 12233 - KU BAND BETA -15 DEG
    - b. DSM 12234 - KU BAND BETA -10 DEG
    - c. DSM 12235 - KU BAND BETA -5 DEG
    - d. DSM 12236 - KU BAND BETA 0 DEG
    - e. DSM 12237 - KU BAND BETA 5 DEG
    - f. DSM 12238 - KU BAND BETA 10 DEG
    - g. DSM 12239 - KU BAND BETA 15 DEG
    - h. DSM 12240 - KU BAND BETA 21 DEG

Note: Any Ku-band TMBUs built in real time will require safing after build.

2. Ku-band beta plus mask command
  - a. DSM 14035 - KU OBSC SEL BETA/MASK
3. Ku-band obscuration override command
  - a. DSM 14030 - KU OBSC OVRD - ON
4. Ku-band RF Protect zone disable commands
  - a. DSM 14038 - KU -BD RF ZONE 1 INH
  - b. DSM 14044 - KU-BD RF ZONE 2 INH
  - c. DSM 14046 - KU-BD RF ZONE 3 INH
  - d. DSM 14048 - KU-BD RF ZONE 4 INH
5. Payload interrogator power commands
  - a. DSM 4806 - PL XMTR PWR OUT - HI
  - b. DSM 4807 - PL XMTR PWR OUT - MD

- B. The commands will be unsafe for real-time usage and resafed after uplink.
- C. If it is not possible to unsafe and safe these commands without operational impact, the INCO must ask the Flight Director for real-time concurrence to leave the commands unsafe. The commands will be resafed at the next operationally feasible time.

**RATIONALE**

- A. The rationale for command safing follows:
  1. Ku-band beta angle commands
  2. Ku-band RF protect box commands
  3. Ku-band beta plus mask command
  4. Ku-band obscuration override command
  5. Ku-band RF protect inhibit command

If these commands are unintentionally sent they may cause the Ku-band antenna to irradiate the crew cabin, an EVA crewmember, a payload, or the ISS. If that happens, it may cause damage to personnel or to critical equipment.

6. Payload interrogator power commands:

If these commands are unintentionally sent, they may cause the payload interrogator antenna to irradiate a payload. Damage to the payload may result in the loss of the forward (command) or return link (telemetry). The payload loss of comm procedures are an additional safeguard.

## TITLE

RECORDER DATA PROTECTION

## PURPOSE

Briefly explain the need for protecting data on the onboard recorders and procedures to

- A. Perform nominal dumps.
- B. Verify good data was received by the MCC.
- C. Special procedures needed to recover onboard recorded voice data if needed.

## GENERAL

In order to ensure that all required recorder data dumps get to the MCC successfully, this data needs to be protected from overwriting on the onboard recorders, until it can be verified that the data was successfully received by the MCC. This protected data includes all ascent and entry data, as well as all data recorded during any significant loss of signal (LOS). The dump FEP report provides the information to verify that the data has been received with acceptable quality. After the acceptable receipt of data has been verified, the data may then be overwritten onboard.

In addition, ascent voice, as well as EVA LOS voice, is not required to be recovered unless a special request for specific time periods of recorded voice is made. The data will be dumped, but no special effort will be made to recover voice, under nominal circumstances. Once the recorded voice is overwritten, voice recovery by the operations support team (OST) is possible, although not time efficient.

## NOMINAL DUMPS

Data will nominally be dumped in the most efficient manner, which implies dumping at 120 IPS in the reverse direction for tape recorders or at 1024 kbps for Solid State Recorder (SSR). Dumps with voice included will nominally be handled as a data-only dump, since the dump FEP will not process and playback voice. Specific command sequences for nominal dumping are covered in the OPS recorder command SCP 3.26 and in the SSR command SCP 3.30.

If data is dumped to a NASA ground site, it may be played back at 1:1 to the MCC, where it will be routed directly to the ODRC, without processing by the dump FEP. The new, upgraded NASA ground site recording equipment can only dump in the forward direction (same direction as received from the orbiter). In order to expedite handling of the playbacks from the site, DFE may ask INST to dump all the data in the forward direction for tape recorders (to receive the data in the forward direction at the MCC).

Data that is dumped via Ku-band or SGLS sites (USAF RTS) will be received at the MCC in real-time and rate reduced and reversal corrected by the dump FEP before playing back to the ODRC.

In the postlanding phase, the dump of entry voice and data will be performed as nominal, which implies at 120 IPS in the reverse direction from the tape recorders or 1024 kbps for SSR. If voice is required, DFE will set up the front end to process voice as it is received from the dump site. This action can require a rate reduction of the dump before sending it to the MCC. Usually KSC can route the dump to MCC at 5:1 as it is being dumped, depending on network capacity; in this case, it is processed by the dump FEP just like an on-orbit dump.

If dumped data is lost due to ground equipment malfunction or operator error after it is overwritten onboard, it can be played back to the dump FEP from the front end (Metrum) tapes for reprocessing. If



the data is not found in the Metrum tapes for any reason, the data can usually be played back from the ground receipt site.

### **VERIFYING GOOD DUMPS**

At the conclusion of a dump, the DFE will send a file of the dump FEP report to the proper INCO directory (/users/inco/rw\_common/dump). The INST will then call up the Dump Report application from INCO DNAV Ground Displays and make a determination, based on the dump FEP report, on whether or not the data can be overwritten onboard. DFE will name the file according to the dump site or satellite and orbit number; e.g., 120tw or 111TDE or 101gts (case sensitive). One hundred frames per second times with no dropouts will be merged by the application into time segments to be verified. Dropouts can be inferred by gaps between the listed 100 percent segments on the dump report.

The size of acceptable gaps can range from 4-30 seconds, depending on operator workload and criticality of the data (gaps of over 8 seconds are rarely accepted without attempts to recover). Gaps of up to 15 seconds for track changes, although preferably avoided by using good recorder management techniques, are considered acceptable.

### **RECOVERING ONBOARD RECORDED VOICE**

If it is determined that voice data that is found only on the recorders (e.g., EVA LOS voice) needs to be recovered, the preferred method of dumping is via the S-band FM system to a NASA ground site at 120 IPS in the forward direction for tape recorders or at 1024 kbps for SSR. The site may be able to rate reduce the dump to 192 kbps when relaying it to the MCC. The MCC front end must be set up in that case to process voice as it is received from the site. In addition, two voice recorder channels must be preempted to capture the dumped voice since there are no spare voice recorder channels.

If no NASA sites with rate reduction capability are available, the data with voice can be dumped at 192 Kbps in the forward direction via Ku or FM to a USAF remote tracking site (RTS). The front end must be set up to process voice at the time of dump.

When a nominal dump of voice and data is made, only the data is processed; however, the dump voice data is also captured on the Metrum recorders and may be recoverable by the OST, using time-consuming manual procedures involving PDRE recorders that could be removed from the MCC at any time.

### **SUMMARY**

Data recorded at 128 kbps needs to be protected only until it is dumped to the MCC and the dump FEP report shows that the dump quality was acceptable. If the data is lost due to a ground problem, the data can still be recovered.

Data and voice recorded at 192 kbps will be nominally dumped without regard to recovery of voice. If a mishap investigation requires recovery of onboard recorded voice, or even of voice overwritten onboard, the voice can usually be recovered.

### **REFERENCES**

Flight Control Operations Handbook (FCOH), vol. I, Shuttle OPS, JSC-22438

Mission Control Center Operations Handbook (MOH), vol. II and III, RSOC 86-0055

## TITLE

RECORDER CABLE SWAP PROCEDURES

## GENERAL

An extension cable is flown on each mission, to be used in the event that the payload recorder in avionics bay 1 has failed and the decision (usually documented in the Flight Rules Annex) is made to use OPS recorder 2 in avionics bay 2 as its replacement. This would be done only if both OPS recorders are operational. The detailed procedure is documented in the IFM checklist and takes approximately 1 hour to complete. It also includes steps for backing out of this configuration before deorbit prep.

## PROCEDURE

- A. The cable is 68.5 inches long and contains six wires. Refer to Figure 3.25-1 for recorder I/O connector designations for the normal wiring configuration. Refer to Figure 3.25-2 for recorder connector designations for the case of OPS 2 in the place of the payload recorder
- B. The IFM procedure also includes the speed plug wiring harness replacement. No other cables are removed.
- C. The end result of performing this IFM is that, when commanding to the new payload recorder, you would
  1. Have the same A1, A2, and B inputs as for the old payload recorder
  2. Use the OPS 2 commands (TRACK, SPEED, MODE, etc.)
  3. Have the old payload recorder speeds assigned to SPEED selects 1-4
  4. Select the OPS RCDR inputs to the FM and Ku-band signal processors when dumping

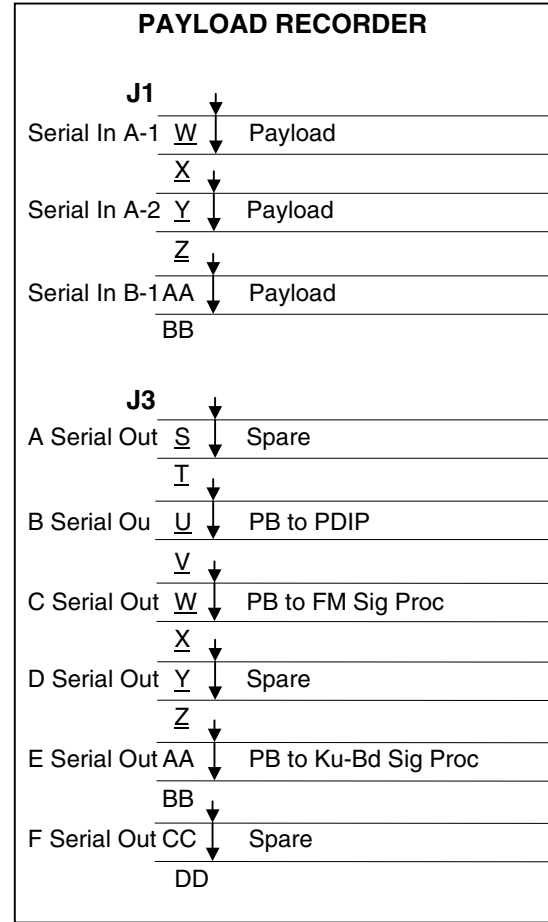
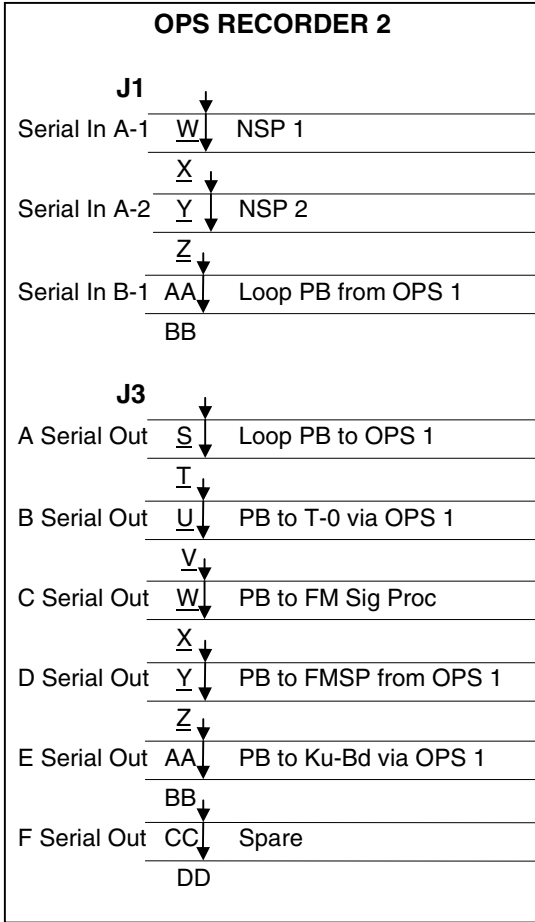
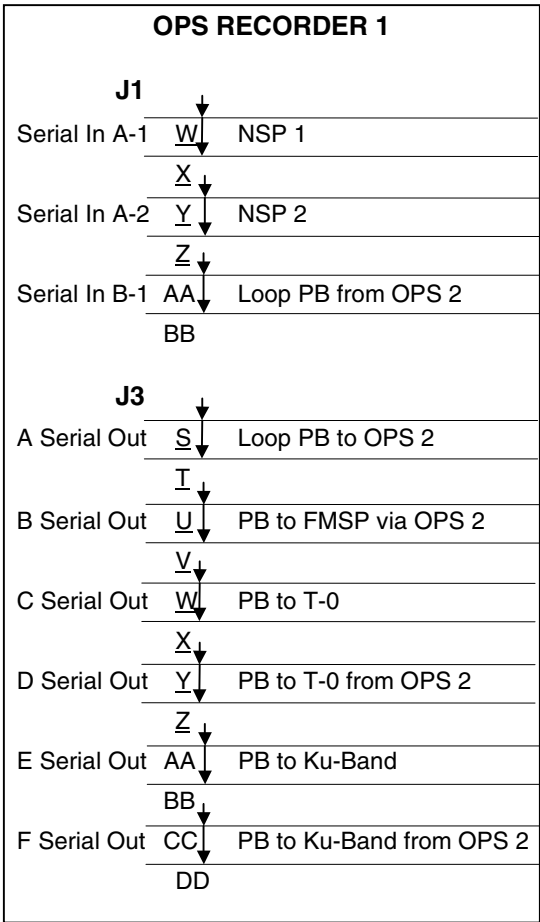


Figure 3.25-1. Nominal recorder configuration

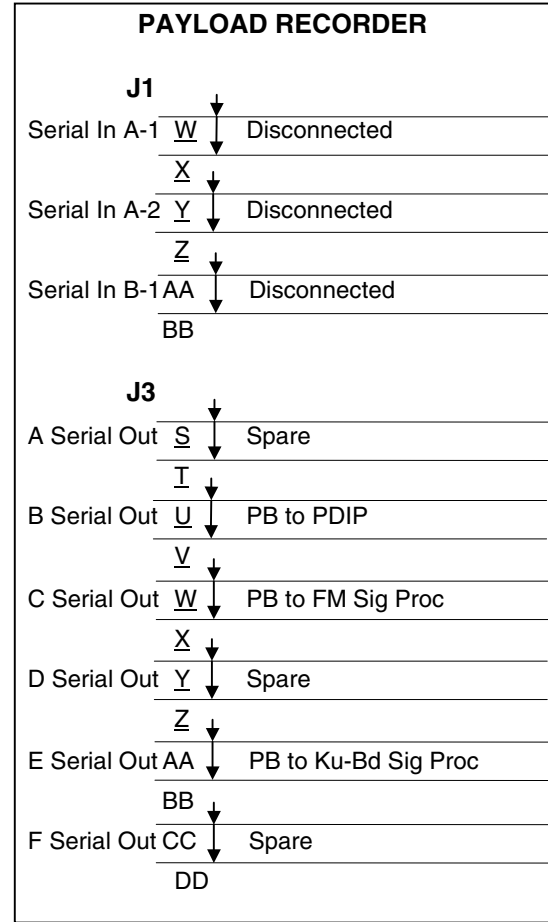
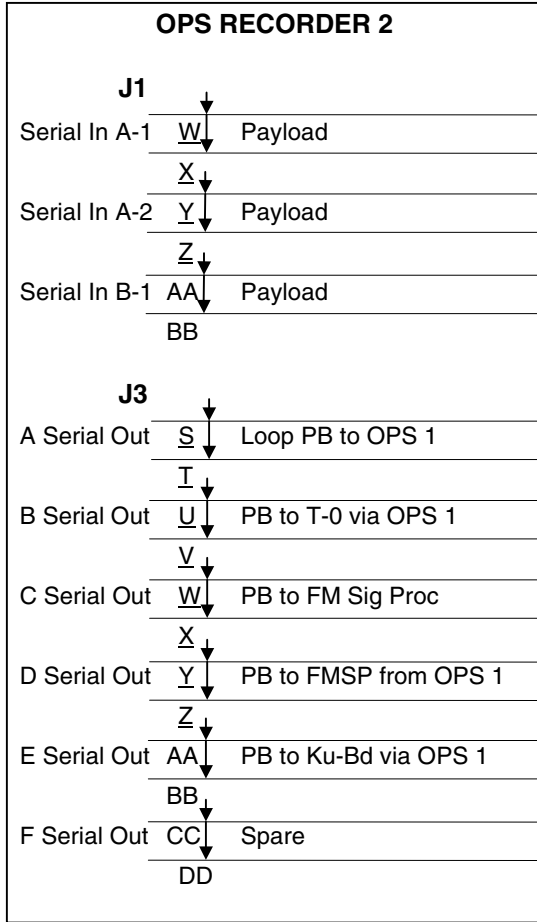
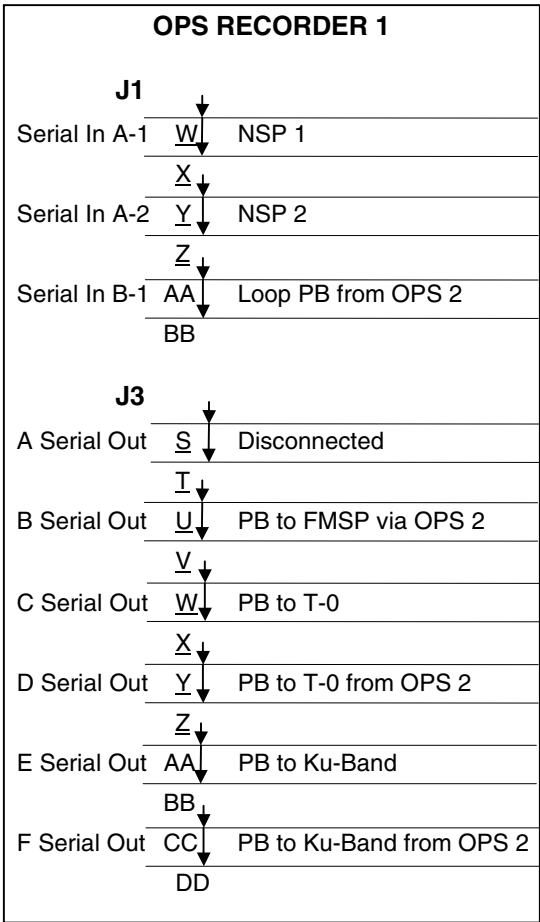


Figure 3.25-2. Recorder configuration with OPS 2 in place of payload recorder

## TITLE

RECORDER SYSTEMS: OPS-1(2) COMMAND CONTROL PROCEDURES

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

## PURPOSE

To define a standard set of command procedures for performing routine recorder operations.

## GENERAL

All commands listed in this SCP are RTCs or MRTCs. The only restriction on uplink is that the commands shall not be uplinked during OPS transitions. There are no constraints relating to flight, vehicle, OI load, major functions, OPS mode, time, or crew/MCC coordination. The RTCs in this procedure are verified and prestored in the command server, and they do not require command server safing.

## RESTRICTIONS & CONSTRAINTS

These procedures are only valid in all ops modes of the GNC, SM and the BFS major functions.

## PROCEDURE

- A. The uplink command sequence (order, as follows, for general recorder operations)
  1. Recorder STOP command
  2. Recorder position commands (EOT/BOT, if required)
  3. TRACK select command (if required)
  4. SPEED select command (if required)
  5. DIRECTION CHANGE command (if required)
  6. Recorder MODE command
- B. General recorder operations
  1. To stop the OPS recorders:  
DSM 4351 (4451) - OPS-1(2) STOP
  2. To position the recorder for a given operation, use one of the following:
    - a. DSM 4356 (4456) - OPS-1(2) REWIND EOT (runs recorder toward End of Tape (EOT))
    - b. DSM 4357 (4457) - OPS-1(2) REWIND BOT (runs recorder toward Beginning of Tape (BOT))

When at desired tape-percentage position:

DSM 4351 (4451) - OPS-1(2) STOP

NOTE

If the OPS 1(2) REWIND BOT/EOT commands are used, the recorder "appears" to be on track 15 since both rewind commands use the parallel playback recorder mode. Track 4 will be selected when a STOP command is sent after the OPS recorder has reached the EOT/BOT position.

3. To select a new track for a given operation:

DSM 4301 through 4314 (4401 → 4414) OPS-1(2) TRACK XX - SEL

4. To select a recorder speed, choose the desired command, as listed.

DSM

	<u>OPS1</u>	<u>OPS2</u>	<u>FUNC</u>	<u>SPD</u>	<u>Kb/sec<sup>1</sup></u>	<u>Nominal use</u>
OPS-1(2) SPEED 24 IPS	4326	(4426)	RCD	1	(192/128) <sup>2</sup>	Record OI data/voice
OPS-1(2) SPEED 120 IPS	4327	(4427)	PB	2	(960/1024)	OI/SSME playback
OPS-1(2) SPEED 7.5 IPS	4328	(4428)	RCD	3	(64)	SSME record <sup>3</sup>
OPS-1(2) SPEED 15 IPS	4329	(4429)	RCD	4	(128)	Record OI data <b>only</b>

<sup>1</sup>Data rates given are the optimized OPS and payload recorder data rates.

<sup>2</sup>NSP VOICE + DATA rate is 192 kb/sec, recorded at 24 IPS and dumped at 960 kb/sec. DATA only rate is 128 kb/sec, recorded at 15 IPS and dumped at 1024 kb/sec. If 128 kb/sec data is recorded at 24 IPS, the result of a 120 IPS playback is 640 kb/sec. For off-nominal recording of 192 kb/sec data at 15 IPS, and depending on the dump site and recorder capability, the dump may be performed at 120 IPS, which provides a 1536 kb/sec dump rate. If the 192 kb/sec cannot be directly recovered from the 1536 kb/sec dump rate, a 15 IPS dump may be required.

(dump data rate) = (recorded data rate) x (dump tape speed) ÷ (recorded tape speed).

<sup>3</sup>SSME EIU main engine controller data at 60 kb/sec each track; center engine = track-1, left engine = track-2, right engine = track-3. Dump rate is 960 kb/sec.

5. To change direction of the recorder from the nominal direction for the desired mode on a given track:

DSM 4324 (4424) - OPS-1(2) CHANGE DIR ON

NOTE

Before another CHANGE DIR ON command can function, a STOP 4351 (4451) command or a CHANGE DIR OFF 4325 (4425) command is required to be issued to the recorder.

6. To record NSP 1 or 2 OI only (128 kb/sec):

- a. DSM 4329 (4429) - OPS-1(2) SPEED 4 SEL

- b. DSM 4315 (4415) - OPS-1(2) RCD SER A. (DSM 4352 (4452) selects both speed 4 and RCD SER A in one RTC)

7. To record NSP 1 or 2 OI and voice (192 kb/sec):
  - a. DSM 4326 (4426) - OPS-1(2) SPEED 1 SEL (not required, since default is speed 1)
  - b. DSM 4315 (4415) - OPS-1(2) RCD SER A (DSM 4350 (4450) selects both speed 1 and RCD SER A in one RTC)

NOTE

If required, NSP RECORD VOICE 1/2 can be turned on (off) by transmitting DSM 4774 (4775).

In addition, there are MRTCs available that will perform the speed, NSP RCD voice, and RCD SER A functions as above. Those MRTCs are listed as follows:

- a. DSM 4360 (4460) - OPS-1(2) D/V RCD 192 (includes 4774 and 4350 (4450))
- b. DSM 4361 (4461) - OPS-1(2) DATA RCD 128 (includes 4775 and 4352 (4452))

Examination of the MRTC INVENTORY display will lead to further insight concerning the composition of the portrayed OPS recorder MRTCs.

8. For nominal play back of NSP 1 or 2 serial data:

DSM 4327 (4427) - OPS-1(2) SPEED 2 SEL

DSM 4317 (4417) - OPS-1(2) PB SER

NOTE

Review MOH, Vol III, Sections 6 (COMMAND) and 7 (DFE/NIP SUP), which highlight their standard operating procedures before, during, and after OPS recorder playback operations.

9. After recording data in the parallel mode (before reconfiguring to serial recording):

DSM 4343 (4443) - OPS-1(2) AUTO/INT RESET

After approximately 10 seconds, recorder reset status of RST appears on MSKview RECORDERS display. To clear the RST status, transmit one of the following:

- a. DSM 4351 (4451) - OPS-1(2) STOP
- b. DSM 43XX (44XX) - OPS-1(2) SELECT TRACK XX (01 - 14)

- C. Space Shuttle Main Engine (SSME) record and playback data operations

Recording of SSME data will begin just prior to exiting the T - 9 min hold as instructed by the S0007 OMI. Termination of SSME data recording is determined by when the SSME Main Engine Controllers (MECs) are powered off by the crews per the Ascent Pocket C/L and also by the various ascent-abort scenarios that can be encountered during powered flight regime. These requirements are outlined as follows:

<u>Cases</u>	<u>Actions</u>
ã Nominal/ATO	Record SSME data until MET of 25 minutes <i>unless</i> BOOSTER calls INCO and requests additional recording time (i.e., MECs powered longer than normal for unspecified reasons).
ḃ Performance/Systems Aborts (AOA, RTLS, TAL)	Record SSME data until EOT, then reconfigure to 24 IPS OI/voice.

NOTE

The following command is called out in OMI S0007. INCO will transmit this command per the OMI.

1. To initiate recording of SSME data (presumes OPS 1 has clean tape and positioned at BOT)

- a. Transmit DSM 4355 - OPS 1 RCD PRL LAUNCH
- b. Verify that OPS 1 telemetry indicates

Mode: RCD-P  
Speed: 3  
Motion: RUN  
Track: 0

2. Prelaunch and powered flight phase recovery procedure for OPS-2 suspect or actual failures



WARNING

KSC will be required to override the Ground Launch Sequencer (GLS) due to an OPS-2 failure prior to T - 5 min 25 sec. Failure to accomplish this will cause an unnecessary hold at T- 5 min, thus potentially jeopardizing time-dependent mission objectives. Apprise KSC personnel immediately if a suspected OPS-2 malfunction occurs before T - 5 min 25 sec.

In the event of a suspected or confirmed malfunction of OPS-2 prior to launch or during powered flight, it is necessary to reconfigure OPS-1. This configuration records SSME data on tracks 1, 2, and 3, and additionally records OI and voice on track 4 at 24 IPS. At EOT, OPS-1 is reconfigured to 24 IPS OI/voice (SERIAL A) via ground commands.

If an OPS-2 malfunction demanding reconfiguration of OPS-1 occurs during prelaunch countdown time period (prior to resuming the count from T - 9 minutes through T - 5 min 25 sec), remind KSC of the OPS-2 failure and GLS hold potential. In addition, advise KSC that we are Go for Launch with only one recorder (per LCC), then wait until T - 6 min before configuring OPS-1. This wait time optimizes SSME record time.

NOTE

There is no risk of causing a launch hold waiting to reconfigure OPS-1 until T - 6 min because the GLS snapshots OPS-2 TEMP and OPS 2 MOTION telemetry at T - 5 min 25 sec. The GLS does not scan OPS-1; therefore, the GLS does not hold for OPS-1 whether it is recording or not.

If an OPS-2 malfunction demanding reconfiguration of OPS-1 should occur after T - 5 min 25 sec and before MEC power off/vacuum inerting occurs, immediately reconfigure OPS-1.

The command sequence to recover from the discussed OPS-2 failures requires OPS-1 be reconfigured as soon as possible in the following manner:

- a. Transmit DSM 4351 - OPS 1 STOP
- b. Verify that OPS-1 telemetry indicates  
Mode: STBY  
Speed: 1 (the STOP command selects 24 IPS/SPEED-1)  
Motion: STOP
- c. Transmit DSM 4318 - OPS 1 RCD PARALLEL
- d. Verify that OPS 1 telemetry indicates  
Mode: RCD-P  
Speed: 1  
Motion: RUN  
Track: 0

NOTE

It is extremely important to log the tape position/percentages on OPS-1 recorder at the time of reconfiguration to reconstruct where the recorder was reconfigured. This is also an aid in assisting the operator when it becomes time to play back the combined SSME- OI/voice data.

a. To terminate SSME recording, perform the following steps:

(1) Transmit DSM-4351 - OPS 1 STOP

(2) Verify that OPS 1 telemetry indicates

Mode: STBY  
Motion: STOP  
Track: 0

(3) Transmit DSM-4343 - OPS 1 AUTO/INT RESET

(4) Verify that OPS 1 telemetry indicates

RCDR RESET: RESET  
Mode: STBY  
Motion: STOP  
Track: 0

**CAUTION**

Protect (do not overwrite) SSME data until it has been played back and is released by a fax originating from MSFC within a couple of hours of SSME playback completion. This fax is forwarded to the GC, who in turn provides a copy to the DATA COMM or INST for SSME data release confirmation and logging purposes.

b. Begin recording OI/voice on OPS 1 in the following manner:

DSM 4351 - OPS 1 STOP  
DSM 4305 - OPS 1 TRACK 5 (6 if EOT) - SEL  
DSM 4326 - OPS 1 SPEED 24 IPS  
DSM 4315 - OPS 1 RCD SERIAL A

c. Verify that OPS 1 telemetry indicates

Mode: RCDA  
Speed: 1  
Motion: RUN  
Track: 5 (6)

3. SSME data playback operations

SSME data will be played back during the first available Ku-band playback opportunity. It is desirable and much easier to play back all SSME data at one time instead of playing back bits and pieces of data. This means that the DATA COMM or INST must work with the INCO and/or RF COMM to plan the playback during times of uninterrupted Ku coverage, thus allowing the playback to be played all at once. In addition, flight-specific requirements could force SSME playback opportunities to occur later on in the mission if the playback is delayed for any reason.

Before an SSME playback is to occur, elements from the Space Network (SN), MILA, and Marshall Space Flight Center (MSFC) must be configured correctly to receive the SSME playback data in real time. It is *not* necessary for MILA or MSFC to receive these data in real time, only *desirable*. WSGT/STGT/NGT records the SSME playback in real time and transmits the playback to a requester as required.

Before initiating the SSME playback, coordinate with and inform DFE and COMMAND that this is an SSME data playback on Ku-band channel 2, which requires a specific Ground Control Message Request (GCMR) be transmitted by COMMAND to the TDRS network (960-kb/sec, data stream ID [DSID] 116). DFE will coordinate with the SN, MSFC, and MILA prior to the playback. It is best to give notice to the DFE at least 45 minutes before initiation of the SSME playback to allow all participants ample time to prepare to receive the SSME playback.

NOTE

If SSME data were recorded at 24 IPS, dump rate will be 300 kb/sec; if OPS-1 was reconfigured for 24 IPS prelaunch, be sure not to mix 300 kb/sec playbacks with 960 kb/sec playbacks (data that were recorded prior to reconfiguring OPS 1 to 24 IPS).

4. Performing an SSME data playback.

To position the OPS recorder correctly for performing the SSME playback, first position tape to the location where SSME recording was terminated. Then follow the subsequent procedure to play back the SSME data in the forward and reverse directions on all three tracks.

a. Transmit the following commands in order:

DSM 4351 - OPS 1 STOP  
DSM 4303 - OPS 1 TRACK 3 - SEL  
DSM 4327 - OPS 1 SPEED 120 IPS  
DSM 4317 - OPS 1 PLBK SERIAL

b. Verify that OPS 1 telemetry indicates

Mode: PLB  
Speed: 2  
Motion: RUN  
Track: 3  
Direction: REV

c. When modulation is lost at the end of data on track 2, transmit the following commands in order:

DSM 4351 - OPS-1 STOP  
DSM 4301 - OPS-1 TRACK 1 - SEL  
DSM 4327 - OPS-1 SPEED 120 IPS  
DSM 4317 - OPS-1 PLBK SERIAL

- d. Verify that OPS-1 telemetry indicates  
Mode: PLB  
Speed: 2  
Motion: RUN  
Track: 1  
Direction: REV
- e. When at BOT on track 1, transmit the following command:  
DSM 4351 - OPS-1 STOP
- f. Verify that OPS 1 telemetry indicates  
Mode: STBY  
Motion: STOP  
Track: 1
- g. Dump all three tracks again in the opposite direction of the first dump sequence, as follows:
- h. Transmit the following commands in order (if necessary):  
DSM 4301 - OPS-1 TRACK 1 SEL  
DSM 4327 - OPS-1 SPEED 120 IPS  
DSM 4324 - OPS-1 CHANGE DIR ON  
DSM 4317 - OPS-1 PLBK SERIAL
- i. Verify that OPS 1 telemetry indicates  
Mode: PLB  
Speed: 2  
Motion: RUN  
Track: 1  
Direction: FWD
- j. When modulation is lost at the end of data on track 1, transmit the following commands in order:  
DSM 4351 - OPS-1 STOP  
DSM 4302 - OPS-1 TRACK 2 - SEL  
DSM 4327 - OPS-1 SPEED 120 IPS  
DSM 4324 - OPS-1 CHANGE DIR ON  
DSM 4317 - OPS-1 PLBK SERIAL
- k. Verify that OPS-1 telemetry indicates  
Mode: PLB  
Speed: 2  
Motion: RUN  
Track: 2  
Direction: REV

- i. When modulation is lost at the end of the data on track 3, perform the following:

DSM 4351 - OPS-1 STOP

- m. Verify that OPS-1 telemetry indicates

Mode: STBY  
Motion: STOP  
Track: 3

D. EVA OPS recorder management

For an EVA, the NSP is configured with voice ON at egress minus 5 minutes. Voice may be configured to OFF after EV crewmembers return to hardline. During the EVA periods, PCMMU OI and voice are recorded. Only ZOE and data losses are dumped. At the crew's option, any recorded ICOM voice may be identified to INCO for retrieval from the OPS recorders.

1. To initiate recording with NSP VOICE 1/2 ON

- a. Presuppose that OPS 1(2) is recording, PCMMU OI data only at 15 IPS and OPS 2 (1) is in standby

OPS 2 (1) D/V RCD 192 - 4460 (4360)

- b. Verify that NSP VOICE 1/2 is ON and OPS-2(1) is at SPEED-1 (24 IPS).

OPS 1(2) STOP - 4351 (4451)

2. To restore OPS recording with NSP VOICE 1/2 OFF

- a. Presuppose that OPS 1(2) is recording at 24 IPS, PCMMU OI and NSP VOICE and OPS 2(1) is in standby

OPS-2 (1) RCD SERIAL 128 - 4461 (4361)

- b. Verify that NSP VOICE 1/2 is OFF and OPS-2(1) is at SPEED-4 (15 IPS).

OPS-1(2) STOP - 4351 (4451)

E. Recorder operations for GPC dump support (coordinate everything closely with INCO)

1. Verify adequate tape will be available for the GPC dump without a track change, per SCP 3.83.

2. After the dump is captured, protect the dumped data until it is released by DPS. To recover GPC dump data recorded on OPS recorders, see SCP 3.83.

F. Recorder operations for entry/postlanding

NOTE

When performing FM recorder dumps while on BFS and in TDRS mode, the UPPER or LOWER HEMI must be selected manually, if required. The ground site can be seen on the Workstation Antenna Management System (WAMS) prediction display to determine which antenna should be selected for the pass.

1. The OPS recorders will record PCMMU OI and voice, with the NSP configured with VOICE 1/2 ON from CDR/PLT seat ingress (see Deorbit Prep C/L - deorbit TIG - 1 hour ) through

wheel stop. Manage the recorders as you would during normal orbit operations (one recorder used for AOS, the other LOS).

To initiate recording OI/voice, perform the following commands in order. (It is desirable to reconfigure the recorder with the coolest head temperature first when the payload bay doors are closed.)

DSM 4351 (4451) - OPS-1(2) STOP  
DSM 43XX (44XX) - OPS-1(2) TRACK XX - SEL (XX should be the lowest numbered track with verified data)  
DSM 4360 (4460) - OPS 1(2) D/V RCD 192

2. If OI/voice recording began at CDR/PLT seat ingress, at no later than TIG - 5 minutes, initiate recording with the other recorder, thereby providing redundant recorded OI/voice data through wheel stop.

NOTE

Verify that there is >5 percent tape position difference between the two recorders to avoid loss of OI/voice during track turnarounds.

DSM 4351 (4451) - OPS-1(2) STOP  
DSM 43XX (44XX) - OPS-1(2) TRACK XX - SEL (XX should be the lowest numbered track with verified data)  
DSM 4350 (4450) - OPS-1(2) RCD SER A (192 kb/sec)

NOTE

After the G9 transition, all recorder command sequences need to be preceded by taking the BFS mode switch to STBY. This action assigns the PL buses to the GNC GPC (GNC must be selected on CCM panel). Once the command sequence is complete, the BFS should be configured back to RUN until the next command sequence. Leaving the BFS in RUN, except when command uplink operations are required, maximizes the BFS downlist for disciplines requiring BFS payload telemetry.

3. Shortly after wheel stop, coordinate with DFE to play back data at KSC/EDW landing sites. When site is configured and ready to receive data, begin playback of data, beginning with the coolest recorder (leave the other recorder running). DFE will confirm data quality with DATA COMM or INST.

NOTE

Complete the flight recorder status sheet per the INCO/COMM Console Handbook SCP 3.81, KSC/MCC Flight Recorder Status Reporting, whether the playbacks are completed or not completed successfully.

DSM 4351 (4451) - OPS-1(2) STOP  
DSM 4327 (4427) - OPS-1(2) SPEED 120 IPS  
DSM 4317 (4417) - OPS-1 PLBK SERIAL (The last recorded track is already selected)

4. When the first OPS recorder playback is terminated, transmit the following commands to configure the recorder for ground-recovery operations:

DSM 4351 (4451) - OPS-1(2) STOP  
DSM 43XX (44XX) - OPS-1(2) TRACK XX - SEL (Select a Track so that the previously dumped entry/voice is not recorded over)  
DSM 4315 (4415) - OPS-1(2) RCD SER A (To activate the track change)  
DSM 4358 (4458) - OPS-1(2) STBY CREW/RESET

Verify the commanded recorder is recording OI/voice at SPEED-1 and is recording on the correct commanded track.

5. After the first recorder is recording via the STBY CREW/RESET command, repeat step 3 and then step 4 (in order) for playback and ground recovery configuration of the other recorder.

G. Miscellaneous procedures

1. To place the OPS recorders under crew switch control  
DSM 4358 (4458) - OPS-1(2) STBY/CREW RESET
2. To place the OPS recorders in a minimum power mode (nonrecord):  
Panel A1R, OPS-1(2) PLAYBACK, STBY, RECORD switches to STBY  
DSM 4358 (4458) - OPS-1(2) STBY/CREW RESET
3. In the event that an OPS AUTO/INT RESET (4343 or 4443) is sent to an OPS recorder and has been executed, it should be followed either by a STOP (4351 or 4451) or a TRACK SEL (43XX or 44XX) command, as appropriate, to clear the RESET command input. Verify the AUTO/INT and its RESET by using the MSKview RECORDERS display.
4. If the crew needs to take control of a given OPS recorder, the following steps may be executed, as appropriate, to clear the desired OPS recorder Multiplexer/Demultiplexer (MDM) interface and give the crew PANEL control.

CAUTION

In addition to the following procedure, the crew can gain control by cycling power on the P/L MDM associated with the recorder the crew wishes to control, but this action will affect associated orbiter subsystems with known (and potential unknown) implications and effects. A PL MDM power cycle is to be performed only as a measure of last resort.

- a. CLEAR OPS RECORDER 1 MDM INTERFACE

SM 1 DPS  
UTILITY

DSM 4358 - OPS 1 STBY/CREW RESET  
ITEM 13 + A 0 8 9 F F F F EXEC  
CMD - ITEM 14 EXEC  
ITEM 13 + A 8 8 9 0 0 0 0 EXEC  
CMD - ITEM 14 EXEC  
Panel A1R: ➡ OPS RCDR 1 PNL CNTL tb = GREY

- b. CLEAR OPS RECORDER 2 MDM INTERFACE

SM 1 DPS  
UTILITY

DSM 4458 - OPS 2 STBY/CREW RESET  
ITEM 13 + A 0 8 A F F F F EXEC  
CMD - ITEM 14 EXEC  
ITEM 13 + A 8 8 A 0 0 0 0 EXEC  
CMD - ITEM 14 EXEC  
Panel A1R: ➡ OPS RCDR 2 PNL CNTL tb = GREY

5. The following procedures were deleted from ORB OPS flight data file and are provided here for reference only:

- a. RCD DATA ONLY

C3 ✓S-BD PM CNTL - CMD

SM 1 DPS  
UTILITY

CRT RTC (RCDR VOICE 1 / 2 - OFF via GCIL A(B))  
ITEM13 + 7 1 0 9 0 1 F F EXEC  
(710A 01FF)  
CMD - ITEM 14 EXEC  
ITEM13 + 7 9 0 9 0 0 5 D EXEC  
(790A 005D)  
CMD - ITEM 14 EXEC

RTC (OPS RCDR 1 (2) RCD SERIAL 128)  
ITEM13 + A 0 8 9 F F F F EXEC  
(A08A FFFF)  
CMD - ITEM 14 EXEC  
ITEM13 + A 8 8 9 8 6 1 0 EXEC  
(A88A 8610)  
CMD - ITEM 14 EXEC

- b. RCD DATA AND VOICE

A1R ✓AUD CTR VOICE RCD SEL CH 1 - ICOM A  
✓CH 2 - ICOM B



C3 ✓S-BD PM CNTL - CMD

SM 1 DPS UTILITY
---------------------

CRT RTC (RCDR VOICE 1 / 2 - ON via GCIL A(B))

ITEM13 + 7 1 0 9 0 1 F F EXEC  
(710A 01FF)

CMD - ITEM 14 EXEC

ITEM13 + 7 9 0 9 0 0 5 E EXEC  
(790A 005E)

CMD - ITEM 14 EXEC

RTC (OPS RCDR 1 (2) RCD SERIAL 192)

ITEM13 + A 0 8 9 F F F F EXEC  
(A08A FFFF)

CMD - ITEM 14 EXEC

ITEM13 + A 8 8 9 8 0 1 0 EXEC  
(A88A 8010)

CMD - ITEM 14 EXEC

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OPS/PL Recorder Information

MEASUREMENTS	OPS 1	OPS 2	PAYLOAD	PRESET
Power On CNTL Bus	V75S2501E (AB1)	V75S2601E (BC1)	V75S2702E (CA2)	
Direction	V75X2505E	V75X2605E	V75X2705E	
Write Protect	V75X2509E	V75X2609E	V75X2709E	False (0)
Delay Interval Timer	V75X2511E	V75X2611E	V75X2711E	
Recording Input B	V75X2513E	V75X2613E	V75X2713E	
Head Temperature	V75T2517A	V75T2617A	V75T2717A	
End of Tape	V75X2521E	V75X2621E	V75X2721E	
Beginning of Tape	V75X2522E	V75X2622E	V75X2722E	
Tape Motion	V75X2523E	V75X2623E	V75X2723E	
Panel Control	V75X2524E	V75X2624E	V75X2724E	
Record	V75X2525E	V75X2625E	V75X2725E	
Playback	V75X2526E	V75X2626E	V75X2726E	
Recorder Full	V75X2527E	V75X2627E	V75X2727E	False (0)
Bite	V75X2529E	V75X2629E	V75X2729E	
Reset	V75X2531E	V75X2631E	V75X2731E	True (1)
Speed Bit 1	V75X2533E	V75X2633E	V75X2733E	All zeros
Speed Bit 2	V75X2534E	V75X2634E	V75X2734E	(SPEED 1)
Percent Tape Bit 1	V75X2540E	V75X2640E	V75X2740E	All zeros,
Percent Tape Bit 2	V75X2541E	V75X2641E	V75X2741E	unless unit
Percent Tape Bit 3	V75X2542E	V75X2642E	V75X2742E	is at EOT,
Percent Tape Bit 4	V75X2543E	V75X2643E	V75X2743E	then all
Percent Tape Bit 5	V75X2544E	V75X2644E	V75X2744E	ones
Active Track Bit 1	V75X2547E	V75X2647E	V75X2747E	
Active Track Bit 2	V75X2548E	V75X2648E	V75X2748E	Track 1
Active Track Bit 3	V75X2549E	V75X2649E	V75X2749E	
Active Track Bit 4	V75X2550E	V75X2650E	V75X2750E	
Function Mode Bit 1	V75X2555E	V75X2655E	V75X2755E	All
Function Mode Bit 2	V75X2556E	V75X2656E	V75X2756E	zeros
Function Mode Bit 3	V75X2557E	V75X2657E	V75X2757E	(STBY)
Run Period Time Bit 1	V75X2559E	V75X2659E	V75X2759E	All zeros (RUN
Run Period Time Bit 2	V75X2560E	V75X2660E	V75X2760E	CONTINUOUS)
Delay Interval Bit 1	V75X2565E	V75X2665E	V75X2765E	All zeros (ZERO
Delay Interval Bit 2	V75X2566E	V75X2666E	V75X2766E	DELAY TIME)
WLOP				False (0)
WLOS				False (0)
LRP				BOT
LRT				Track 1
LRD				Forward

**PANEL STATUS**

**CNTL:**  
Gray Crew BP ERASE  
BP MCC PB SER PB FWD  
PB SER PB REV

**Mode (PL):**  
RCD SER RCD  
PB PLAYBACK BP STOP  
BP STBY RCD PRL RCD  
RCD RECORD PB PRL PB REV  
PB PRL PB FWD

**OPS RCDR SPEEDS PL RCDR SPEEDS**

1 - 24ips D+V (A/E/EVA)	6 ips (OARE)
2 - 120 ips PB	7.5 ips
3 - 7.5 ips ME (ASC)	15 ips (SL)
4 - 15 ips Data (ORB)	30 ips (SL, OARE)
	38 ips
	60 ips (SL, OARE)

**BITE STATUS PROCESSING**

Current limiter temp high (> 180° F)  
Head temp high (> 140° F)  
Pressure high (> 25 psia)  
Commutator signal not present  
Transport unit analog V HI/LO  
Transport unit logic V low  
Bias signal low  
Electronics unit logic V low  
Electronics unit analog V HI/LO  
Servo Error

**TEMPERATURES**

STBY @ 120° F BITE @ 140° F

Tape Speed (ips)	Record data rate (kbps)		Record time (hr:min)		Max binary dump ratio	Max dump ratio
	min	max	per track	total		
6	25.6	51.2	1:20	18:40	16:1 (96 ips)	20:1
7.5	32.9	64	1:04	14:56	16:1 (120 ips)	16:1
9.5	40.5	81	:50	11:40	8:1 (76 ips)	12.6:1
12	51.2	102.4	:40	9:20	8:1 (96 ips)	10:1
15	64	128	:32	7:28	8:1 (120 ips)	8:1
19	81.1	162.1	:25	5:50	4:1 (76 ips)	6.3:1
24	102.4	204.8	:20	4:40	4:1 (96 ips)	5:1
30	128	256	:16	3:44	4:1 (120 ips)	4:1
38	162.1	324.2	:12	2:55	2:1 (76 ips)	3.15:1
48	204.8	409.6	:10	2:20	2:1 (96 ips)	2.5:1
60	256	512	:08	1:52	2:1 (120 ips)	2:1
76	324.3	648.5	:06	1:27		1.58:1
96	409.6	819.2	:05	1:10		1.25:1
120	512	1024	:04	:56		1.1:q:E

RECORD	PLAYBACK	KBPS
60 @ 7.5	120	960
60 @ 24	120	300
128 @ 15	120	1024
128 @ 24	120	640
192 @ 15	120 (15)	1536 (192)
192 @ 24	120	960

dump data rate =  $\frac{\text{record data rate} \times \text{dump tape speed}}{\text{record tape speed}}$

**OSCILLATORS AND SPEEDS**

120 - 120/60/30/15/7.5  
96 - 96/48/24/6  
76 - 76/38/19/9.5

	FM SP	FM XMTR	FM SW
Location:	AV Bay 3A Tray/Shelf 1	AV Bay 3A Tray/Shelf 2 MA16F	AV Bay 3A Tray/Shelf 2 MA16F
Cooling:	Air	Water loops	Air
	FM 1	FM 2	
Power Source:	CNTL BC1 MNB FLC 2	CNTL BC2 MNC FLC 3	
	FM ANT SEL L (V74S6506E)	ANT POS S5B (V74X6676E)	
	FM ANT SEL R (V74S6505E)	ANT POS S5A (V74X6675E)	
	FM CONTROL (V74S6550E)		

**LCC** - INS-02 Verified OPS RCDRs not failed prior to T - 5  
Failed: BITE, temp > 120° F, unable to detect tape motion  
OPS 1 BITE, but temp ok, keep recording

**FR** - A11.1.2-21 ASC: If OPS 2 failed, reconfigure OPS 1 24 ips  
ORB: OPS fail no impact to mission duration

A11.1.1-9 RECORDER USAGE

**IFM** - RECORDER CHECKOUT (2 OPS FAILED); RECORDER JUMPER  
CABLE INSTALLATION (PL, OPS) (must be two good OPS)

**SB** - RCDR: 13,50; FM: 11

**SSSH** - RCDR: 16.18,16.19; FM: 16..8

Approx. Record Time per segment (sec)
6 ips - 152
7.5 ips - 120
15 ips - 64
24 ips - 40
120 ips - 6

Command Order: TRACK (if req'd), SPEED (if req'd), CHG DIR (if req'd), MODE

OPS/PL Recorder Information (concluded)

	OPS 1	OPS 2	PAYLOAD
<b>LOCATION</b>	AV Bay 2 Tray/Shelf 2 MF71E	AV Bay 2 Tray/Shelf 2 MF57G	AV Bay 1 Tray/Shelf 2 MF43G
<b>COOLING:</b>	Water loops	Water loops	Water loops
<b>POWER SOURCE:</b>			
RPC A	CNTL AB1 MNA FPC 1	CNTL BC1 MNB FPC 2	CNTL CA1 MNA FPC 1
RPC B	CNTL AB2 MNB FPC 2	CNTL BC2 MNC FPC 3	CNTL CA2 MNC FPC 3

MODE	Speed (ips)					
	6.0	15	24	60	120	0
	<b>Power (watts)</b>					
Repro serial	65	65	72	76	84	
Record serial	53	55	56	60	67	
Record parallel analog	68	70	71	75	83	
Repro parallel analog	81	83	84	88	100	
Record parallel digital	67	69	70	75	82	
Loop	54	55	56	60	68	
Loop dump	71	73	74	78	87	
Erase				60		
Standby						17

RECORDER MODE				RECORDER SPEED			RCDR DELAY TIME			RECORDER PERCENT TAPE					
bit 1	bit 2	bit 3	MODE	bit	bit	SPEED	bit	bit 9	SPEED	bit 1	bit 2	bit 3	bit 4	bit 5	%
0	0	0	STBY (stop)	0	0	1	0	0	NONE	0	0	0	0	0	0
1	0	0	RCDA	1	0	2	1	0	1	1	0	0	0	0	3
0	1	0	PB	0	1	3	0	1	2	0	1	0	0	0	6
1	1	0	LOOP	1	1	4	1	1	3	1	1	0	0	0	10
0	0	1	RCDB							0	0	1	0	0	13
1	0	1	RCDB							1	0	1	0	0	16
0	1	1	PB-P							0	1	1	0	0	19
1	1	1	STOP (halt)							1	1	1	0	0	23
										0	0	0	1	0	26
										1	0	0	1	0	29
										0	1	0	1	0	32
										1	1	0	1	0	35
										0	0	1	1	0	39
										1	0	1	1	0	42
										0	1	1	1	0	45
										1	1	1	1	0	48
										0	0	0	0	1	52
										1	0	0	0	1	55
										0	1	0	0	1	58
										1	1	0	0	1	61
										0	0	1	0	1	65
										1	0	1	0	1	68
										0	1	1	0	1	71
										1	1	1	0	1	74
										0	0	0	1	1	77
										1	0	0	1	1	81
										0	1	0	1	1	84
										1	1	0	1	1	87
										0	0	1	1	1	90
										1	0	1	1	1	94
										0	1	1	1	1	97
										1	1	1	1	1	100

bit 1	bit 2	RUN	bit	bit 14	bit	bit 16	TRACK
0	0	CONT	1	0	0	0	1
1	0	1	0	1	0	0	2
0	1	2	1	1	0	0	3
1	1	3	0	0	1	0	4
			1	0	1	0	5
			0	1	1	0	6
			1	1	1	0	7
			0	0	0	1	8
			1	0	0	1	9
			0	1	0	1	10
			1	1	0	1	11
			0	0	1	1	12
			1	0	1	1	13
			0	1	1	1	14

<b>PF1</b> - OPS 1, PL RCDR	BOT/EOT show track 15 while in motion; track 4 when stopped
<b>PF2</b> - OPS 2	(xrcdrmgmt shows track 4 while in motion) RCDP shows track 0

STBY/CREW RST - RCDA, speed 1, if panel set up correctly  
if RCDP, go to RCDA, speed 1, track 4, direction reversed

DSC OF1	MDM OF1	MDM OF2	MDM OF4
PL RCDR Head Temp	OPS 1 AB1 PWR ON OPS 1 MNA ON (V76X4383E)	OPS 1 MNB ON (V76X4384E)	OPS 2 Direction, Write Protect Delay Interval Timer
<b>DSC OF2</b>	PL RCDR RPC A ON (V76X4380E)	Direction Write Protect Delay Interval Timer Recording Input B	Delay Interval Timer Recording Input B EOT, BOT, Tape Motion Full
OPS 1 & 2 Head Temps OPS 1 & 2 Panel Cntl tb OPS 1 & 2 Mode tb	Direction Write Protect Delay Interval Timer Recording Input B Head Temp EOT, BOT Tape Motion Full	Head Temp EOT, BOT Tape Motion Full Bite Reset Speed Bits Percent Tape Bits Active Track Bits Mode Bits Run Time Bits Delay Time Bits	Full Bite Reset Speed Bits Percent Tape Bits Active Track Bits Mode Bits Run Time Bits Delay Time Bits
<b>MDM OF3</b>	OPS 2 MNC ON (V76X4387E) PL RCDR PWR ON (CA2) PL RCDR RPC C ON (V76X4382E) FM SYS 1 ON (V74X6120E) FM SYS 2 ON (V74X6121E) FM RF OUTPUT 1 (V74E6650A) FM RF OUTPUT 2 (V74E6651A)	OPS 2 BC1 PWR ON OPS 2 MNB ON (V76X4386E) OPS 2 Head Temp	FM OPS RCDR (V74X4800E) FM Main Engine (V74X4801E) FM PL RCDR (V74X4802E) FM PL DIGI (V74X4803E) FM PL ANLG (V74X4804E) FM DOD (V74X4805E) FM TV (V74X4806E)

**TITLE**

RECORDER SYSTEMS: PAYLOAD RECORDER COMMAND CONTROL PROCEDURES

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

To define a standard set of command procedures for performing payload (P/L) recorder operations.

**RESTRICTIONS & CONSTRAINTS**

These procedures are only valid in all ops modes of the GNC, SM and the BFS major functions.

**GENERAL**

All commands listed in this SCP are RTC's or MRTC's. There are no restrictions on uplink. There are no constraints relating to flight, vehicle, OI load, major function, OPS mode, time, or crew/MCC coordination. The RTC's in this procedure have been verified and prestored in the command server, and they do not require command server safing. These commands can be considered routine and continuous.

**PROCEDURE**

A. The uplink command sequence should be ordered as follows for general operations:

1. Recorder STOP CMD
2. Recorder position CMD's (if required)
3. Track select CMD (if required)
4. Speed select CMD (if required)
5. Direction change CMD (if required)
6. Recorder mode CMD

B. All commands are RTC MCM functions unless otherwise noted.

C. General recorder operations

1. To stop the P/L recorder:  
P/L STOP - 4551
2. To position the recorder for a given operation:  
P/L REWIND EOT - 4556, runs recorder toward EOT  
or  
P/L REWIND BOT - 4557, runs recorder toward BOT

When at desired position:  
P/L STOP - 4551

NOTE

If the P/L rewind BOT/EOT command is used, the recorder will be on track X, where X is the first serial track after the parallel tracks specified on the recorder for the mission. This is because the rewind CMD's use the parallel playback recorder and modes.

3. To select a new track for a given operation:  
P/L TRACK XX - 4501-4514

4. To select a recorder speed, choose the desired command:

			<u>FUNC</u>	<u>RATE (IPS)**</u>	<u>KBPS**</u>
*P/L	SPEED 1	- 4526	RCD	6	(25.6-51.2)
P/L	SPEED 2	- 4527	RCD	7.5	(32.9-64)
P/L	SPEED 3	- 4528	RCD	38	(162.1-324.2)
P/L	SPEED 4	- 4529	PB	120	(512-1024)

\* It is never necessary to send this command if the STOP CMD has been sent as stated in paragraph A above. The STOP CMD actually selects speed 1 since the speed bits are zeroed by the STOP CMD. Zeros in the speed bit field select speed 1 or 6 IPS.

\*\* The four speed selections wired in the P/L recorder program plug may vary from mission to mission based on data requirements. Any 4 of the 14 available speeds may be wired on the program plug for a given mission. As of now, only two plugs are used. The one shown (speeds 6, 7.5, 38, and 120 ips) is used for nominal missions; other flights may use speed selects of 15, 30, 60, and 120 ips, respectively.

5. To change the direction of the recorder from the nominal direction for the desired mode on a given track:  
P/L CHANGE DIR ON - 4524

NOTE

Before another CHANGE DIR ON(4524) command will take affect, a STOP(4551) or a CHANGE DIR OFF(4525) must be sent.

6. To record serial input A:  
P/L RCD SER A - 4515
7. To record serial input B:  
P/L RCD SER B - 4516
8. To PB serial data:  
P/L PB SER - 4517

- D. In order to save onboard stored program command (SPC) buffer space, P/L RCDR record serial and record parallel modes have also been built with an associated speed as stacked recorder commands. These digital select matrix (DSM) numbers should be used for SPC activities requiring record operations.

P/L RCD SER A SPD 1 4550  
P/L RCD SER A SPD 2 4552  
P/L RCD SER A SPD 3 4559  
P/L RCD SER A SPD 4 4560

P/L RCD SER B SPD 1 4561  
P/L RCD SER B SPD 2 4562  
P/L RCD SER B SPD 3 4563  
P/L RCD SER B SPD 4 4564

P/L RCD PRL SPD 14571  
P/L RCD PRL SPD 24572  
P/L RCD PRL SPD 34573  
P/L RCD PRL SPD 44574

E. Miscellaneous procedures

1. To put the P/L RCDR under crew switch control:  
P/L STBY CREW RST - 4558
2. To put the P/L RCDR in a minimum power mode (nonrecord):  
PNL A1R, P/L RCDR FUNCTION SW - MODE SEL, AND INCO CMD PL STBY CREW RST - 4558
3. Any time a P/L AUTO INT RESET (4543) is sent to the P/L RCDR and has been executed, it should be followed by a STOP (4551) to clear the RESET CMD input.
4. If the crew needs to take control of the P/L recorder and E.1 did not work, then the following procedure can be executed to clear the P/L recorder/MDM interface and give them panel control.

CLEAR PAYLOAD RECORDER MDM INTERFACE

SM 1	DPS	UTILITY
------	-----	---------

RTC (PL CREW RESET)  
ITEM 13 + 0 0 0 9 F F F F EXEC  
CMD - ITEM 14 EXEC

ITEM 13 + 0 8 0 9 0 0 0 0 EXEC  
CMD - ITEM 14 EXEC

A1R      √PL RCDR PNL CNTL tb - gray

Additionally, the crew could gain control of the P/L recorder by cycling the power on P/L MDM no. 1, but this action has other systems implications and effects.

## TITLE

MADS/OEX ACTIVATION/DEACTIVATION AND OPERATION

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

## PURPOSE

Define procedures used for Modular Auxiliary Data System (MADS)/Orbiter Experiment (OEX) system activation, deactivation, and normal operations.

## RESTRICTIONS & CONSTRAINTS

These procedures are only valid in all ops modes of the GNC, SM and the BFS major functions. In OV-103, OV-104, and OV-105, crew has sole control over MADS PCM record mode (sample or continuous).

## GENERAL

The commands listed in this SCP are all RTCs. They have no restrictions on uplink. The only constraint is that the vehicles have unique MADS/OEX equipment that is specified in the following procedures. Transmitting one of these commands to the wrong vehicle would cause no impact. There are no other constraints relating to flight, vehicle, OI load, major function, OPS mode, time, or crew/MCC coordination. The RTCs in this procedure have been verified and prestored in the MOC, and only the MADS RCDR PWR OFF command requires safing. The MADS RCDR PWR OFF command should not be sent until tape motion has stopped. The MADS WB ON and MADS PCM ON commands should not be sent until the RCDR PWR ON command has been sent. Verification that the MADS RCDR PWR ON command has been sent can be confirmed by the recorder BITE good indication. This command is sent first to avoid unnecessary interruptions in recorder power when sending MADS PCM OFF and MADS WB OFF. Sending these commands while the recorder power switch is in PCM/WB ENABLE and the MADS RCDR PWR ON command has not been sent removes power from the recorder before tape motion is stopped, which can damage the tape and/or cause the tape to fall out of the tape path. The commands can be considered routine and continuous, which requires only initial flight director approval for uplink.

### CAUTION

Uplink of DSM 4619 MADS RCDR PWR OFF while the recorder tape is in motion may cause loss of the MADS recorder. STS-53 post-flight investigation revealed that an inadvertent MADS OFF/STBY command, which removed power to the recorder while the tape was in motion, contributed to the unrecoverable loss of tape tension. DSM 4619 should be unsafe only when intended for use.



**PROCEDURES**

A. COMMAND CONCERNS

All of these commands will be built into the command server, and some will be uplinked via the command panel. Commands normally will be sent by the INST, except for prelaunch. It is the INST's call as to when he/she informs the INCO of any commands sent. INCO or INST must be informed beforehand of any MADS/OEX commands sent.

B. ACTIVATION

1. Vehicle 102

Switch Configuration for Control by the MCC:

PNL A7L OEX EQUIP - ON  
PNL C3 MASTER OEX POWER - ON  
PNL A7L MADS FDM - DATA

This is all that is required onboard. The OEX system on OV-102 is intended for ground control only.

OEX systems are controlled in OV-102 by the OEX Sequence Control Module (SCM). The OEX experiments are normally activated by sending a label to the SCM, which activates a preprogrammed command sequence. This sequence then executes, configuring the SCM. OEX commanding is controlled by the OEX Command Plan, SCP 3.31. The contents of the label can be found in the OEX System Control Module Mission PROM Labels document.

2. Vehicle 103/104/105

Switch configuration for control by the MCC

PNL A6L cb MADS PWR MNB - CL  
PNL C3 MSTR MADS PWR - ON  
PNL A6L MADS RCDR PWR-PCM/WB ENA  
PB FWD - CMD  
STRAIN GAUGE - PCM ENA  
WB/ACIP PCM - CMD  
PCM - CMD  
RCD MODE - SAMPLE  
FDM CNTL - DATA  
MAN CALBR - N/A

<u>Uplink command</u>	<u>DSM</u>
MADS RCDR PWR ON	4618
Confirm RCDR BITE = GOOD	
MADS WB/ACIP - ON	4601
Confirm that recorder is in RCD, motion indicates RUN, and recorder is pulling tape	
MADS PCM - ON	4603
MADS CAL - ON	4607
Wait 10 seconds	
MADS CAL - OFF	4608

C. DEACTIVATION

The MADS system is to be deactivated whenever recording is complete. Note that the snapshot mode on orbit and the snapshot mode postlanding for thermal soakback data is no longer required.

1. Vehicle 102

- a. Immediate or emergency power down (crew action only)

PNL C3 MASTER OEX POWER - OFF

or

PNL A7L OEX EQUIP - OFF

- b. Nominal power down per OEX CMD SCP 3.31

2. Vehicle 103/104/105

- a. Immediate or emergency power down (crew action only)

PNL C3 MASTER MADS POWER - OFF

or

PNL A6L cb MADS PWR - OPEN

Note: MCC must uplink DSM 4619, MADS RCDR PWR OFF to remove power from the recorder.

- b. Nominal power down and post-landing procedure

<u>Uplink command</u>	<u>DSM</u>
MADS RCDR PWR ON	4618
(This is a precautionary measure to apply power via PF1)	
MADS CAL - ON	4607
Wait 10 seconds	
MADS CAL - OFF	4608
MADS WB/ACIP OFF	4602
MADS PCM - OFF	4604
Verify no tape motion.	
MADS OFF/STBY	4600
MADS RCDR PWR OFF	4619

D. REPOSITIONING THE RECORDER, TRACK SEQUENCE SELECTION

1. OV-103/104/105

To reposition the MADS tape to BOT or EOT, the MADS RCDR REWIND BOT and MADS RCDR REWIND EOT commands, DSM 4605 and 4606, respectively, are used. The rewind EOT (or BOT) commands do not control power to the recorder. To rewind or fast forward the recorder, power must be supplied via panel A6L RCDR Power ON or by using the MADS RCDR PWR ON command, DSM 4618. Before reaching EOT or BOT, it is important to let the recorder cool a few minutes as a precautionary measure by stopping the recorder before reaching BOT/EOT and then resuming the reconfiguration after a short pause. This can be done by sending MADS STDBY/OFF, DSM 4600, before reaching BOT or EOT. This

procedure should be used to avoid creating a sticky tape problem where the heat generated near the tape melts part of the substance and causes the tape to adhere to the electronics, hence the "sticky tape." MADS STDBY OFF, DSM 4600, MUST always be sent after using the MADS RCDR REWIND BOT/EOT commands and the repositioning is complete in order to reset any relays set by the MADS RCDR REWIND BOT/EOT commands.

<u>Uplink command</u>	<u>DSM</u>
MADS RCDR PWR ON	4618
(This is a precautionary measure to apply power via PF1 )	
MADS RCDR REWIND BOT (EOT)	4605 (4606)
Once BOT( EOT) is reached:	
MADS STDBY/OFF	4600

#### NOTES

- a. Because of the time required to shuffle tape, caution must be exercised when using either rewind command.
- b. The PB FWD command resets relay K7, which controls tape direction. Use of this command, RWD EOT, will reset track sequence 2 if this mode was active. To reestablish sequence 2, the RCDR must reach EOT and then be rewound to the percent tape required.
- c. The recorder does not have an erase-before-write capability. If the rewind BOT is used and you record over data, both the old and new data are useless.
- d. Activating Sequence 3

The MADS recorder automatically selects track sequence 2 once it reaches EOT. However, once the MADS recorder reaches BOT on track sequence 2, the recorder goes to a standby mode until track sequence 3 is initiated from the ground. MADS TRACK SEQ 3 ON, DSM 4609 must be sent in order to record on track sequence 3. MADS TRACK SEQ 3 OFF, DSM 4610 is not normally used. It could be used, however, if for some reason one needed to continue recording on track sequence 1 or 2 again. If this command must be used, pay careful attention to notes b and c.

<u>Uplink command</u>	<u>DSM</u>
MADS TRACK SEQ 3 ON	4609

## 2. OV-102

Because OV-102 OEX System of "label" commanding is highly complicated, a detailed plan of commanding as prescribed in SCP 3.31 is followed verbatim. Normally independent repositioning of the OEX Recorder as detailed in this section is not required. If directed to divert from SCP 3.31 and independently move the position of the OEX Recorder Tape Position, please contact Dwight Favors (ext. 3-5458) who will properly instruct you as to how these "independent" commands will affect the PROM "Labels".

The SCM GO TO BOT and SCM GO TO EOT commands, DSM 5749 and 5750 respectively, can be used to go to BOT or EOT; however, they should NOT be used to move the OEX recorder tape to any point other than BOT or EOT. Stopping short of either causes the SCM to be "confused" because the requested action was not completed. The SCM then refuses to accept any CONTINUE AT LABEL commands until an ALLSTOP command is issued. The

best way to move a tape to a desired point other than BOT or EOT, if this point is not "marked," is to employ speed and direction commands to reposition the recorder at 60 ips.

a. To reposition the recorder to BOT or EOT:

<u>Uplink command</u>	<u>DSM</u>	<u>ECHO</u>
-----------------------	------------	-------------

First, power must be applied to the recorder.

SCM DISCRETE ON	5740	86
SCM DECIMAL 32	5732	20
SCM ENTER	5736	99

Next, the recorder is commanded to reposition itself:

SCM GOTO BOT	5749	B4
or (SCM GOTO EOT)	5750	B6
SCM ENTER	5736	99

When the desired location is reached:

SCM ALLSTOP	5766	AE
SCM ENTER	5736	99

b. To reposition the tape to a percent tape other than BOT or EOT:

<u>Uplink command</u>	<u>DSM</u>	<u>ECHO</u>
-----------------------	------------	-------------

First, power must be applied to the recorder:

SCM DISCRETE ON	5740	86
SCM DECIMAL 32	5732	20
SCM ENTER	5736	99

Next, the recorder is commanded to reposition itself:

SCM DIR FORWARD	5743	A2
or (SCM DIR REVERSE)	5744	A4
SCM SPEED	5747	A8
SCM DECIMAL 7	5707	07
SCM ENTER	5736	99

When the desired location is reached:

SCM ALLSTOP	5766	A3
SCM ENTER	5736	99

NOTE

The OEX recorder does not have an erase-before-write capability. If the rewind BOT is used and you record over data, both the new and old data are useless.

E. NOMINAL OPERATIONS

Flight-specific requirements mandate different operational plans for the MADS and OEX systems. Most flights require only ascent and entry data. Therefore, the MADS and OEX systems activation is performed for ascent and entry only. On orbit and postlanding, the systems are deactivated. On-orbit data requirements are identified in the Flight Requirements Document. OEX and MADS command plans for a specific flight are developed by the lead INST and are located on console during the flight.

1. Unique requirements/exceptions are:

- a. During some flights of OV-102, the Orbital Acceleration Research Experiment (OARE) has 32-kpbs "burst mode" data recorded at 6 IPS on the payload recorder or on the E1 input to the Solid State Recorder. For a specific flight, the lead INST will develop an operational plan for the SSR or payload recorder dumps in conjunction with SCP 3.31.
- b. Track sequence 2 is avoided because limitations in the post-mission processing system at KSC. Therefore, the recorder is repositioned to BOT and then track sequence 3 is activated for the entry data take (at NO LATER THAN TIG - 15 minutes).

2. Prelaunch:

- T - 33h30m MADS FDM/PCM test (OV-103/104/105) (VL4 SEQ 38)
- T - 32h30m MADS PCM/RCDR sample test (OV-103/104/105) (VL4 SEQ 38)
- T - 18h00m OEX/FDM/PCM test (OV-102) (VL4 SEQ 38)
- T - 17h30m MADS RCDR configure for LCD (OV-103/104/105) (VL4 SEQ 38)  
Manual cals and PNL C3/A6L switch configurations  
OEX RCDR configure for LCD (OV-102) (VL4 SEQ 38)  
FDM track assignments and manual cals  
PNL C3/A7L switch configurations
- T - 03h00m (hold) OARE activation/PLR or SSR to record OARE data (VL2 SEQ 16)
- T - 00h12m Activate OEX recorder (OV-102) (VL4 SEQ 38)
- T - 00h09m Activate MADS recorder (VL4 SEQ 38)

3. Ascent

The MADS system is activated during the T - 9 hold and nominally remains active until MECO + 06 m. In a launch hold/scrub case, allow 30 minutes of record time in order to be safe. Recall that there are 120 minutes available on each track sequence of the MADS recorder. Keep in mind that EOT may actually be reached (and most often is) before the percent tape counter indicates 100 percent. Also, flight-specific on-orbit data takes may require that the reconfiguration be performed prior to 25 percent tape used in order to conserve tape. This type of coordination information should be determined by the lead INST prior to the flight. Note that the MCC-H recycle steps for MADS are located in S0007, Volume 2, sequence 23.

- (a) Nominal ascent/ATO
    - OV-103/104/105 - AT MECO + 6 m, perform MADS deactivation
    - OV-102 - Manage the OEX system per SCP 3.31
  - (b) TAL
    - OV-103/104/105 - Nominal postlanding deactivation at wheel stop + 2 m
    - OV-102 - Manage the OEX system per SCP 3.31
  - (c) RTLS
    - OV-103/104/105 - Nominal postlanding deactivation at wheel stop + 2 m
    - OV-102 - Manage the OEX system per SCP 3.31
  - (d) AOA (two Freon loops or two H2O loops) - Expect Master MADS/OEX OFF
    - OV-103/104/105 - MADS RCDR PWR OFF (DSM 4619)
    - OV-102 - Manage the OEX system per SCP 3.31
4. D/O MADS Recorder Checkout - One hour before the deorbit burn, a checkout of the MADS recorder should be performed to allow time for troubleshooting if needed. If Shelf 7 temp is over 20° F at checkout time, it should be warm enough (30° F) for proper operation by EI. Otherwise, you may need to get the crew to switch panel A6L STRAIN GAUGE –ON.
- Perform MADS activation. If proper tape motion is observed, deactivate the MADS until the entry data take or else perform SCP 4.22.
- If vehicle 104 and still configured on track sequence 1 or 2, perform reconfiguration to BOT to prepare for entry data take. This action will also verify proper tape operation.
5. Entry
- (OV-103/104/105) MADS systems are to be activated at TIG - 15 minutes. Recording is to continue until EI + 2500 seconds, when the MADS deactivation procedure should be performed. At wheel stop plus 2 minutes, a calibration should be performed to ensure a calibration is performed prior to EOT being reached.
- To perform a calibration:
- MADS CAL ON (DSM 4607) wait 10 seconds
  - MADS CAL OFF (DSM 4608)
- For OV-102, SCP 3.31 should be followed for the entry procedures.
6. Postlanding
- MADS system deactivation is performed at EI + 2500 seconds.
- F. FDF LOCATIONS (NOT INCLUDING THE MALFUNCTION PROCEDURES BOOK)
- Switchlist configurations just confirm switch positions in case they are out of place.

1. Nominal
  - a. Ascent Checklist (Not Flown Pages) - Switchlist for crew handover
  - b. D/O Prep Checklist -
    - (1) Entry Aft Flight Deck Config - Checks proper switch configuration
    - (2) D/O Prep Backout Summary Timeline - Callout to perform on-orbit Htr/MADS config (MS)
    - (3) D/O Prep Backout Detailed Timeline - ET 01:20 - Callout to perform on-orbit Htr/MADS config (MS)
    - (4) On-Orbit Htr/MADS Config - Checks proper switch configuration
    - (5) Entry switchlist/verification
2. Off-nominal procedures - Most of these procedures perform MSTR MADS/OEX PWR - OFF on C3 as a power saving measure.
  - a. Ascent Pocket
    - (1) ECLS Procedures: H2O LOOP PRESS LOW ( HIGH), EVAP OUT T HIGH
    - (2) EPS Procedures: MN BUS UNDER VOLTS FC VOLTS, AC1 (2 or 3 $\phi$ s), MNA DA1, AC2 (2 or 3 $\phi$ s), MNB DA2, AC3 (2 or 3 $\phi$ s), MNC DA3, FC STACK T, FC EXIT T, FC SHUTDOWN (1st), 2nd FC SHUTDOWN, FC SAFING
    - (3) PWRDWN Procedures: LOSS OF 2 CAB FANS, LOSS OF CAB PRESS (MAJOR PWRDN), LOSS OF 2 H2O LOOPS (POST OMS-2), LOSS OF 1 FREON LOOP, LOSS OF HI LOAD EVAP, LOSS OF 2 FREON LOOPS (POST OMS-2), LOSS OF FES/1 FC, LOSS OF 2ND FC
  - b. Ascent/Entry Systems
    - (1) ECLS Procedures: Loss of two Freon Loops
    - (2) EPS Procedures: MN BUS UNDER V/FC V, MN A, MNB, MNC, FC pH  $\downarrow$  1(2,3) or FC DELTA V 1(2,3), FC STACK T, FC EXIT T, FC COOLANT PUMP  $\Delta$ P LOW (powered flight only), FC COOL P, FC SHUTDOWN (1st), CRYO O2(H2) LEAK (three or more tanks aff) (powered flight only)
  - c. Orbit Pocket
    - (1) ECLS Procedures: EVAP OUT T HIGH, FREON FLOW LOW
    - (2) EPS Procedures: MN BUS UNDERVOLTS FC VOLTS, FC SHUTDN (1st), 2nd FC SHUTDN, FC SAFING
    - (3) PWRDWN Procedures: LOSS OF 2 CAB FANS, LOSS OF 2 H2O LOOPS, LOSS OF CAB PRESS, LOSS OF HI LOAD EVAP, LOSS OF 1 FREON LOOP, LOSS OF 2ND FC ON-ORBIT (TIG < 4 hr AND TIG > 4 hr), LOSS OF 2 FREON LOOPS, LOSS OF FES
  - d. Entry Pocket

- (1) ECLS Procedures: H2O LOOP PRESS LOW (HIGH), EVAP OUT T HIGH
  - (2) EPS Procedures: MN BUS UNDER VOLTS FC VOLTS, FC STACK T, FC EXIT T, FC SHUTDOWN (1st), 2nd FC SHUTDOWN, FC SAFING
  - (3) PWRDWN Procedures: LOSS OF 2 CAB FANS, LOSS OF CAB PRESS (MAJOR PWRDN), LOSS OF 2 H2O LOOPS (ENTRY), LOSS OF 1 FREON LOOP OR HI LOAD EVAP (ENTRY), LOSS OF 2 FREON LOOPS (ENTRY), LOSS OF FES, LOSS OF 1 FC, LOSS OF 2ND FC (ENTRY)
- e. Contingency D/O Prep
- (1) ENTRY SWITCH LIST/VERIFICATION
  - (2) LOSS OF 2 FC SW VERIF
  - (3) EMERGENCY DEORBIT PREP/ENTRY LOSS OF CAB PRESS PWRDN

MADS OPS NOTES

5. The MADS control module timer (for PCM sample mode) is not reinitialized by mode changes. The timer will cycle whenever the MCM is powered.
5. At Pulse-Code Modulation Unit (PCMU) powerup, the PCMU bite will toggle while the bite circuit is initialized.
5. At RCDR powerup, RCDR may indicate tape motion until motion circuit is fully powered.
5. The AUTO CAL command must remain high for 2 seconds to be active.
5. The FDM will indicate DATA for data mode on the tab if the FDM is on and not being calibrated. If it is off or being calibrated, data mode will show CAL.
5. Sending TRACK SEQ 3 OFF while in TRACK SEQ 3 will automatically switch recorder back to TRACK SEQ 1 at the same percent tape and moving in the same direction.

OEX OPS NOTES

5. The OEX System Control Module (SCM) controls the recorder and the MADS system. Turning off the SCM will turn off both of them.
5. The only telemetry from the OEX system is from the OEX recorder, through the SCM, and the SCM command echo/error codes. No SCM temperature, discrete status, or PCM configuration is downlinked.
5. In case of a power interruption for more than 2 ms, the SCM will store all system parameters in battery-protected memory. When power returns, the SCM will restore the OEX system to its previous configuration.
5. When a GOTO MARK command is issued, no CONTINUE AT LABEL commands can be issued until the recorder has reached the mark, as verified by the absence of tape motion. To issue a label command before the mark is reached and the recorder is stopped causes the SCM to miss the mark and permits the recorder to run to the tape end. Furthermore, the SCM will not accept any label commands until an ALLSTOP command is issued.
5. Do NOT send a GOTO MARK command when you are at that mark's position. For example, if the present position is 20 percent and the desired position (mark position) is 20 percent, do NOT send a GOTO MARK command sequence. This command will result in the SCM being confused, and it will enter an unrecoverable state.



**Table 3.28-1. MADS equipment temperature management**

Site/ mission phase	System equipment operating	Temperature at initial activation, °F	Operating thermal rate increase time, min/Δ°F	Cooldown	
				Method	Thermal rate decrease time, min/Δ1°F
Launch (no hold)	Full system (17 min operation)	85	↑ 2.4	N/A	N/A
On orbit*	PCM - snapshot (with/without SGSC)	No system thermal constraint for operation in the snapshot mode within the operating temperature from 30° to 140° F		System cooldown prior to entry can be achieved in either snapshot or powerdown mode to ensure a shelf temperature of ≤100° prior to entry initiation. The difference in the shelf temperature rate between the snapshot and powerdown modes is insignificant because of the extremely low snapshot duty cycle, with all other conditions equal. In the ZLV attitude with the shelf temperature at 104° F, it will require 15 hours to reach 100° F with the MADS system powered off. In the Sun attitude, for the same conditions, 38 hours is required to reach 100° F	
	Full system - continuous	100	↑ 1.5		
	PCM only - continuous	100	↑ 9.5		
Entry/ landing	Full system	<100	↑ 2.3	MADS configured as required by mission	

\*MADS continuous component operation on orbit is not recommended (except just prior to entry) because of the rapid temperature rise rate associated with this condition.

## TITLE

RECOVERY FROM INADVERTENT PARALLEL RECORDING ON THE PAYLOAD RECORDER

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

## GENERAL

The payload recorder does not erase before recording in the parallel mode. Inadvertent recording uses tape that normally only can be erased and reused by an ERASE/RESET, which destroys all data already recorded. This procedure uses the serial erase heads to clear a portion of the tape. It assumes no input connected to the serial inputs.

## COMMAND RESTRICTIONS/CONSTRAINTS

***The recorder commands are valid in all Ops modes of all major modes; only constraint - control of the PL MDM's and buses are needed.***

## PROCEDURE

- A. If EOT encountered, cycle recorder power.

If EOT not encountered, send 4543 AUTO INT RST (remember to wait 10 seconds) and verify reset on the Recorder Management display.

- B. Rewind to desired percent tape.

- C. Command TRACK 1 - 4501 (or lowest number track required)  
120 IPS - 4529  
RCD SER A - 4515

- D. When recorder has incremented tracks and recorded to percent tape where last desired parallel recording occurred, send STOP - 4551.

If the inadvertent recording was done at the beginning or middle of the track(s), when the recorder has recorded past the desired percent tape, send the following commands:

STOP - 4551  
TRACK 2 - 4502  
RCD SER A - 4515

Then continue to record to percent tape where last desired parallel recording occurred and send STOP - 4551.

- E. Command TRACK 3 - 4503  
120 IPS - 4529  
RCD SER A - 4515

- F. Repeat steps D and E using tracks 5, 7, 9, etc., until all needed tracks are clear.
- G. Resume normal ops.

NOTE

Step A is required to reset record lockouts. If the crew is busy, 4543 AUTO INT RESET can substitute for a power cycle as far as this procedure is concerned, but if EOT was encountered, a power cycle must be performed before any further parallel recording can take place.

## TITLE

RECORDER SYSTEMS: SSR 1(2) COMMAND CONTROL PROCEDURES

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

## PURPOSE

To define a standard set of command procedures for performing routine solid state recorder (SSR) operations.

## GENERAL

All commands listed in this SCP are RTCs. Most RTCs in this procedure are verified and prestored in the GCS, and most do not require safing. The positional RTC's that are built during the mission are covered in this SCP. RTC's that are safed are listed in INCO Systems Brief Section 40.

## RESTRICTIONS & CONSTRAINTS

These procedures are valid in all ops modes of the GNC, SM and BFS major functions. There are no special restrictions on execution of these procedures. The only restriction on uplink is that the commands shall not be uplinked during OPS transitions. There are no constraints relating to flight, vehicle, OI load, major functions, OPS mode, time, or crew/MCC coordination.

- A. The SSR will reject commands that are invalid for a particular mode or command sequence. Valid mode transitions, as well as the list of pre-built commands, are described in Systems Brief 40.
1. The following commands are *invalid* in any mode *except* STANDBY:
    - a. Maintenance commands: RESET, SELF TEST, ERASE, REMAP
    - b. Non-queued playback (PB) or Space Shuttle Main Engine (SSME) PB
    - c. Store or recall a position
  2. The following command sequences must be completed to avoid a rejection of a subsequent command:
    - a. Maintenance command ENABLE followed by related EXECUTE command
    - b. Define PB queue START followed by queue END command
  3. Refer to SB 40, Table 40-14, for a complete list of commands allowed per mode.
- B. Commands that could cause a significant loss of recorded data are *not* expected to be used regularly and are nominally safed:
1. Clear *all* PB queue slots
  2. Unprotect parallel data
  3. Maintenance commands

C. Positional commands must be built real-time per section G of this SCP, because the position is embedded in the command:

1. Record or PB at a position
2. Auto-stop at a position
3. Define a PB queue

## PROCEDURE

A. General SSR operations

1. To stop an operation:
  - a. DSM 9252 (9352) - SSR 1(2) HALT (stops all operations)
  - b. DSM 9235 (9335) - SSR 1(2) STOP SER RCD
  - c. DSM 9236 (9336) - SSR 1(2) STOP PAR RCD
  - d. DSM 9238 (9338) - SSR 1(2) STOP PB
  - e. *OR* build and uplink a command per section G for serial record auto-stop at a position
  - f. After using the auto-stop, uplink a clear auto-stop RTC or SPC as needed to ensure the auto-stop does not execute unexpectedly the next time around

DSM 9237 (9337) - SSR 1(2) CLR AUTO STOP

2. There is a feature to suspend recording at the current position, and the position can be stored in a register to return to recording later. To store a current position (while in STANDBY mode) for future operation and subsequently return to that position (while in STANDBY mode):
  - a. DSM 9239 (9339) - SSR 1(2) STORE POS1
  - b. DSM 9240 (9340) - SSR 1(2) STORE POS2
  - c. DSM 9241 (9341) - SSR 1(2) RECALL POS1
  - d. DSM 9242 (9342) - SSR 1(2) RECALL POS2

3. To record OI data at input A:

DSM 9200 (9300) - SSR 1(2) RCDA (starting at the current indicated position)

*OR* build and uplink a command to RCDA starting at a desired position per section G.

### NOTE

If required, NSP RECORD VOICE 1/2 can be turned ON (OFF) by transmitting DSM 4774 (4775).

4. To record payload data at input B:

DSM 9201 (9301) - SSR 1(2) RCDB (starting at the current indicated position)

*OR* build and uplink a command to RCDB starting at a desired position per section G.

5. Data can be played back at various rates, but the preferred rate for OD (NSP) data is 1024 Kbps with or without voice. We also need to consider other ground user requirements when playing back data. For example, when dumping Data + Voice via Ku Band, notify COMMAND that voice is present so that the appropriate GCMR will be used. To select a PB rate as a multiple of the recorded rate:

<u>Kb/sec RCD</u>	<u>Multiple</u>	<u>Kb/sec PB</u>	<u>Nominal use</u>
60	16	960	SSME*
64	16	1024	IUS data
32	32	1024	OARE burst data

\*SSME EIU main engine controller data at 60 kb/sec each E input; E1 = center engine, E2 = left engine, E3 = right engine.

6. For a non-queued PB (commanded while in STANDBY mode):

DSM 9203-9209 (9303-9309) - SSR 1(2) PB (select PB rates from 2048 to 32, PB starts at the current indicated position)

*OR* build and uplink a command to PB at the desired rate starting at a desired position per section G.

NOTE

Review MOH, Vol III, Sections 6 (COMMAND) and 7 (DFE/NIP SUP), which highlight their standard operating procedures before, during, and after OPS recorder playback operations.

7. To define a PB queue, build and uplink the sequential commands to define the start and end of the PB queue per section G.
8. To clear a PB queue slot:
- DSM 9220-9234 (9320-9334) - SSR 1(2) CLR PBQ (select queue 1-F)
9. To PB all queued data for a certain rate:

DSM 9214-9218 (9314-9318) - SSR 1(2) PB QUE (select rate 2048-128)

B. Space Shuttle Main Engine (SSME) record and playback data operations

Recording of SSME data will begin just prior to exiting the T - 9 min hold as instructed by the S0007 OMI. Termination of SSME data recording is determined by when the SSME Main Engine Controllers (MECs) are powered off by the crews per the Ascent Pocket C/L and also by the various ascent-abort scenarios that can be encountered during powered flight regime. These requirements are outlined as follows:

Cases

Nominal/ATO

Performance/Systems Aborts  
(AOA, RTLS, TAL)

Actions

Record SSME data until MET of 25 minutes *unless* BOOSTER calls INCO and requests additional recording time (i.e., MECs powered longer than normal).

Record SSME data until SSR reconfigures itself to serial A mode for OI/voice on TAL, or until ready for post-landing dump on RTLS.

NOTE

The following command is called out in OMI S0007. INCO will transmit this command per the OMI.

1. To initiate recording of SSME and OI data (presumes SSR 2 is clean)

- a. Transmit DSM 9302 - SSR 2 RCDP
- b. Verify that SSR 2 management display indicates

Mode: RCDP

Position: 162 (OI serial A position when first started)

BITE: GOOD

E data source code and P data status code for positions 0-161

2. OI data will also be recorded on SSR 1, unless a payload is using input B during launch phase (unlikely).

If an SSR 2 malfunction occurs during pre-launch countdown time period, make sure that OI data is being recorded on SSR 1. Payload data may be recorded in the "engine data region" simultaneous with OI data on SSR 1 by using the parallel recording mode (flight specific configuration).

The Ground Launch Sequencer (GLS) monitors the BITE status of both recorders and will cause a launch hold if both recorders are outputting zero for critical BITE failure (CBF) status. The LCC requires one recorder for launch. The GLS monitors this status from T-6 hours to T-5 minutes.

3. To terminate SSME recording, perform the following steps:

- a. Transmit DSM 9336 - SSR 2 STOP PAR RCD
- b. Verify that SSR 2 management display indicates

Mode: RCDA

E data source code and P data status code for positions 0-161

**CAUTION**

Protect (do not overwrite) SSME data until it has been played back and is released by a fax originating from MSFC within a couple of hours of SSME playback completion. This fax is forwarded to the GC, who in turn provides a copy to the DATA COMM or INST for SSME data release confirmation and logging purposes.

4. SSME data playback operations

SSME data will be played back during the first available Ku-band playback opportunity. It is desirable and much easier to play back all SSME data at one time instead of playing back bits and pieces of data. This means that the DATA COMM or INST must work with the INCO and/or RF COMM to plan the playback during times of uninterrupted Ku coverage, thus allowing the playback to occur contiguously. In addition, flight-specific requirements could force SSME playback opportunities to occur later on in the mission if the playback is delayed for any reason.

Before an SSME playback is to occur, elements from the Space Network (SN), MILA, and Marshall Space Flight Center (MSFC) must be configured correctly to receive the SSME playback data in real time. It is *not* necessary for MILA or MSFC to receive these data in real time, only *desirable*. WSC records the SSME playback in real time and transmits the playback to a requester as required.

Before initiating the SSME playback, coordinate with and inform DFE and COMMAND that this is an SSME data playback on Ku-band channel 2, which requires a specific Ground Control Message Request (GCMR) be transmitted by COMMAND to the TDRS network (960-kb/sec, Bi-Ø-L, data stream ID [DSID] 116). DFE will coordinate with the SN, MSFC, and MILA prior to the playback. It is best to give notice to the DFE at least 45 minutes before initiation of the SSME playback to allow all participants ample time to prepare to receive the SSME playback.

5. Performing an SSME data playback.

The SSR can sequentially PB data recorded for three SSMEs using the PBME 960 command, but to satisfy a requirement from KSC ground processing, queues will be built and dumped as follows:

- a. Calculate SSME (EIU) number of positions ( $N_p$ ) recorded in parallel mode, where  $N_p = \{\text{number of seconds recording in parallel} \div 70 \text{ sec/position}\}$
- b. Positions containing EIU1 data = POS 0 through POS  $N_p$
- c. Positions containing EIU2 data = POS 54 through POS  $54 + N_p$
- d. Positions containing EIU3 data = POS 108 through POS  $108 + N_p$
- e. Build separate 960 rate queues for EIU 1, 2, 3 data, + 6 extra segments at the end of the first two queues to provide 26 second gaps (containing all "ones")
- f. When DFE is ready, dump all three 960 queues (simultaneously recording). When you get to the end of recorded data, you will see an NCBF only while dumping all ones.

C. EVA recorder management

For an EVA, the NSP is configured with voice ON (DSM 4774) at egress minus 5 minutes. Voice is configured to OFF (DSM 4775) after the EV crew return to hard line. During the EVA periods, PCMMU OI and voice are recorded. Only ZOE and data losses are dumped. At the crew's option, any recorded ICOM voice may be identified to INCO for retrieval from the SSR.

D. Recorder operations for GPC dump support (coordinate everything closely with INCO)

Before and after the dump is captured, protect the data until it is released by DPS. Play back GPC dump data recorded on SSR per SCP 3.83.



- E. If cryo savings goals for a mission require powering off MMU2, delay powering MMU2 off until after the SSME data is released by MSFC, and keep both MMUs powered up after Ku stow. Depending on the mission, modifications to the Group B Power Up/Down callouts in the flight plan may be required.
- F. Recorder operations for entry/post landing

NOTE

When performing FM recorder dumps using BFS antenna management in the TDRS mode, the UPPER or LOWER HEMI must be selected manually, using the WAMS site COMP to determine the appropriate antenna

1. The SSRs will record PCMMU OI and voice, with the NSP configured with VOICE ON (DSM 4774), from CDR/PLT seat ingress (see Deorbit Prep C/L - deorbit TIG - 1 hour ) through wheel stop. Manage the SSRs as you would during normal orbit.
2. If OI/voice recording began at CDR/PLT seat ingress, at no later than TIG - 5 minutes, initiate recording with the other SSR, thereby providing redundant recorded OI/voice data through wheel stop.

NOTE

After the G9 transition, all SSR command sequences need to be preceded by taking the BFS mode switch to STBY. This action assigns the PL buses to the GNC GPC (GNC must be selected on CCM panel). Once the command sequence is complete, the BFS should be configured back to RUN until the next command sequence. Leaving the BFS in RUN, except when command uplink operations are required, maximizes the BFS downlist for disciplines requiring BFS payload telemetry.

3. Shortly after wheel stop, coordinate with DFE to play back data at KSC/EDW landing sites. When site is configured and ready to receive data, begin playback of data. Dump all data with voice from one or both SSRs as required to get all the voice dumped.

NOTE

Complete the flight recorder status sheet per the INCO/COMM Console Handbook SCP 3.81, KSC/MCC Flight Recorder Status Reporting, whether the playbacks are completed or not completed successfully.

4. When either SSR playback is terminated, make sure the SSR is still recording voice and data, and enable the record auto-stop at the lowest numbered segment of non-verified data (per section G) to prevent overwriting in the event that the SSR reaches that position before being stopped.
- G. Positional commands are built using the SSR management application. The Flight Controller should delete any built command after it is no longer needed.
    1. The following table lists the command DSM and value limits for SSR 1(2), for reference only:

**SSR buildable command table**

The first 32 bits define the reset command and the next 32 bits define the set command. The 10 least significant bits (LSB) define the position, from 0 to 810 (32A<sub>H</sub>). The SSR management application uses certain command titles (if uplinked exactly as indicated below) to set status indicators on the display.

nnn = decimal equivalent of position placed into command title  
 NNN = last 12 bits of command, including 10 position bits  
 MIN(MAX) = minimum(maximum) hexadecimal value of NNN

COMMAND TITLE	HEX COMMAND DATA	MIN	MAX
<b>BUILDABLE RTCs 1000-1049</b>			
SSR1 RCDA @nnn	0009 FFFF 0809 0NNN	400	72A
SSR1 RCDB @nnn	0009 FFFF 0809 0NNN	800	B2A
SSR1 RCDP @nnn	0009 FFFF 0809 0NNN	C00	F2A
SSR1 PB2048 @nnn	0009 FFFF 0809 1NNN	000	32A
SSR1 PB1024 @nnn	0009 FFFF 0809 1NNN	400	72A
SSR1 PB960 @nnn	0009 FFFF 0809 1NNN	800	B2A
SSR1 PB192 @nnn	0009 FFFF 0809 1NNN	C00	F2A
SSR1 PB128 @nnn	0009 FFFF 0809 2NNN	000	32A
SSR1 PB64 @nnn	0009 FFFF 0809 2NNN	400	72A
SSR1 PB32 @nnn	0009 FFFF 0809 2NNN	800	B2A
SSR1 Q START @nnn	0009 FFFF 0809 3NNN	000	32A
SSR1 Q END 2048 @nnn	0009 FFFF 0809 ENNN	000	32A
SSR1 Q END 1024 @nnn	0009 FFFF 0809 ENNN	400	72A
SSR1 Q END 960 @nnn	0009 FFFF 0809 ENNN	800	B2A
SSR1 Q END 192 @nnn	0009 FFFF 0809 ENNN	C00	F2A
SSR1 Q END 128 @nnn	0009 FFFF 0809 FNNN	000	32A
SSR1 AUTO-STOP @nnn	0009 FFFF 0809 4NNN	400	72A
<b>BUILDABLE RTCs 1050-1099</b>			
SSR2 RCDA @nnn	A08A FFFF A88A 0NNN	400	72A
SSR2 RCDB @nnn	A08A FFFF A88A 0NNN	800	B2A
SSR2 RCDP @nnn	A08A FFFF A88A 0NNN	C00	F2A
SSR2 PB2048 @nnn	A08A FFFF A88A 1NNN	000	32A
SSR2 PB1024 @nnn	A08A FFFF A88A 1NNN	400	72A
SSR2 PB960 @nnn	A08A FFFF A88A 1NNN	800	B2A
SSR2 PB192 @nnn	A08A FFFF A88A 2NNN	C00	F2A
SSR2 PB128 @nnn	A08A FFFF A88A 2NNN	000	32A
SSR2 PB64 @nnn	A08A FFFF A88A 2NNN	400	72A
SSR2 PB32 @nnn	A08A FFFF A88A 2NNN	800	B2A
SSR2 Q START @nnn	A08A FFFF A88A 3NNN	000	32A
SSR2 Q END 2048 @nnn	A08A FFFF A88A ENNN	000	32A
SSR2 Q END 1024 @nnn	A08A FFFF A88A ENNN	400	72A
SSR2 Q END 960 @nnn	A08A FFFF A88A ENNN	800	B2A
SSR2 Q END 192 @nnn	A08A FFFF A88A ENNN	C00	F2A
SSR2 Q END 128 @nnn	A08A FFFF A88A FNNN	000	32A
SSR2 AUTO-STOP @nnn	A08A FFFF A88A 4NNN	400	72A

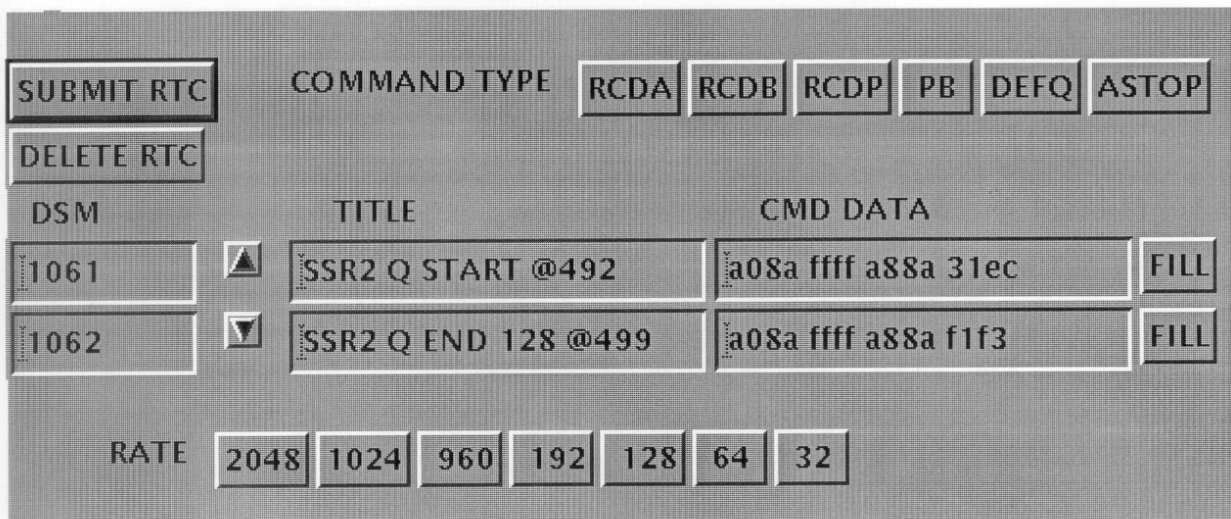
- The application will build the command title and data per the table above. The display will also fill in a default DSM number, i.e., the lowest number not already in the server; if no 1000(1050) series RTCs are in the server, the number used will be 1000(1050).

To open the SSR management command build menu: either click the CMD button, select the command type, and fill in the position number as required; or right mouse click or swipe on the data code (D, V, B, or E) and select the **command build** option. A swipe is used to define the start and end of a PB queue, and a click is used to define the position for the other commands.

SEQ	Action	Comments
1	Select command type (RCDA, RCDB, RCDP, PB, DEFQ, ASTOP [auto stop])	Display will fill in DSM, title, and position at this time. If building PB or PBQ CMD, PB rate is blank.
2	If PB or DEFQ command, select rate	Display will fill in PB rate in title
3	Click on FILL	Display will fill in command data
4	Select the Submit RTC option	

The buildable RTCs existing in the server for the appropriate SSR will be displayed in the command window. RTCs defining a PB queue should be left in the server until the dumped data is verified.

Figure 3.30-1 is an example of the SSR positional RTC build window of the display.



**Figure 3.30-1. Example of SSR2 positional command build display**

If required, any position number previously fed into the application can be edited; if this editing is done before “FILL” is selected, the proper data for the edited position will be filled into the command.

- Positional commands can also be built without the help of this application, using the following technique:





SSR Information

MEASUREMENTS	SSR 1	SSR 2	PRESET
Power On (CNTL Bus)	V72S7185E (AB1)	V72S7186E (AB2)	
Auto Stop Enable	V75X2959E	V75X2859E	False (0)
Parallel Protect	V75X2950E	V75X2850E	False (0)
Mode MSB 6	V75V2966E	V75V2866E	0
Mode Bit 5	V75V2965E	V75V2865E	0
Mode Bit 4	V75V2957E	V75V2857E	0
Mode Bit 3	V75V2956E	V75V2856E	0
Mode Bit 2	V75V2955E	V75V2855E	0
Mode LSB 1	V75V2944E	V75V2844E	0
Position MSB 10	V75V2949E	V75V2849E	0
Position Bit 9	V75V2948E	V75V2848E	0
Position Bit 8	V75V2947E	V75V2847E	0
Position Bit 7	V75V2934E	V75V2834E	0
Position Bit 6	V75V2933E	V75V2833E	0
Position Bit 5	V75V2921E	V75V2821E	0
Position Bit 4	V75V2913E	V75V2813E	0
Position Bit 3	V75V2911E	V75V2811E	0
Position Bit 2	V75V2909E	V75V2809E	0
Position LSB 1	V75V2905E	V75V2805E	0
Queue Count MSB 4	V75V2941E	V75V2841E	0
Queue Count Bit 3	V75V2940E	V75V2840E	0
Queue Count Bit 2	V75V2931E	V75V2831E	0
Queue Count LSB 1	V75V2929E	V75V2829E	0

RCD/PB Rate (Kbps)	Time Per Segment (sec)
32	131.1
60	69.9
64	65.5
128	32.8
192	21.8
960	4.4
1028	4.1
2048	2

RECORD	PLAYBACK	MULTIPLE
192	960	5
128	1024	8
60	960	16
64	1024	16
32	1024	32

	FM SP	FM XMTR	FM SW
<b>Location:</b>	AV Bay 3A Tray/Shelf 1	AV Bay 3A Tray/Shelf 2 MA16F	AV Bay 3A Tray/Shelf 2 MA16F
<b>Cooling:</b>	Air	Water loops	Air
	<b>FM 1</b>	<b>FM 2</b>	
<b>Power CNTL</b>	CNTL BC1	CNTL BC2	
<b>Source:</b>	MNB FLC 2	MNC FLC 3	

**LCC -** INS-02 Verify SSRs not failed prior to T - 5  
Failed: BITE CBF

**FR -** A11.1.2-21 ASC: SSR2 RCD PAR (nominally)  
ORB: SSR fail no impact to mission duration  
A11.1.1-9 RECORDER USAGE

**SB -** SSR: 40; FM: 8  
**SSSH -** SSR: 16.21; FM: 16.8

MDM OF3	MDM OF1	MDM OF2	MDM OF4
FM SYS 1 ON (V74X6120E) FM SYS 2 ON (V74X6121E) FM RF OUTPUT 1 (V74E6650A) FM RF OUTPUT 2 (V74E6651A) FM ANT SEL L (V74S6506E) FM ANT SEL U (V74S6505E) ANT POS S5B (V74X6676E) ANT POS S5A (V74X6675E) FM CONTROL, GCIL (V74S6550E)	All SSR 1 Telemetry	All SSR 2 Telemetry	FM SSR2 (V74X4800E) FM Main Engine (V74X4801E) FM SSR1 (V74X4802E) FM PL DIGI (V74X4803E) FM PL ANLG (V74X4804E) FM DOD (V74X4805E) FM TV (V74X4806E)

PBQ RATE	RATE CODE	BACKGROUND COLOR
960	0	Light blue
128	1	Pink
192	2	Yellow-green
1024	4	Light green
2048	8	Light blue-green

SSR Information (concluded)

VAL	MODE	DESCRIPTION
0	NONE	MMU power down or loss of mode telemetry
1	STBY	Standby, no record or playback or maintenance operation in process
2	RCDA	Recording Serial A, NSP1(NSP2) data or data and voice
3	RCDB	Recording Serial B, payload input
4	RCDE	Recording main engine or payload data at the EIU1(2, 3) inputs
5	RCDP	Recording three EIU inputs and Serial A input
6	PB2048	Dumping at 2048 Kbps
7	PB1024	Dumping at 1024 Kbps
8	PB960	Dumping at 960 Kbps
9	PB192	Dumping at 192 Kbps
10	PB128	Dumping at 128 Kbps
11	PB64	Dumping at 64 Kbps
12	PB32	Dumping at 32 Kbps
13	PBME	Dumping all EIU data in 1,2,3 order at 960 Kbps
14	PB E1	Dumping EIU1 data at 60 Kbps
15	PB E2	Dumping EIU2 data at 60 Kbps
16	PB E3	Dumping EIU3 data at 60 Kbps
17	PBQ2048	Dumping all data slots queued at 2048 Kbps
18	PBQ1024	Dumping all data slots queued at 1024 Kbps
19	PBQ960	Dumping all data slots queued at 960 Kbps
20	PBQ192	Dumping all data slots queued at 192 Kbps
21	PBQ128	Dumping all data slots queued at 128 Kbps
22	A/PB2048	Simultaneously recording Serial A data and dumping per mode 17
23	A/PB1024	Simultaneously recording Serial A data and dumping per mode 18
24	A/PB960	Simultaneously recording Serial A data and dumping per mode 19
25	A/PB192	Simultaneously recording Serial A data and dumping per mode 20
26	A/PB128	Simultaneously recording Serial A data and dumping per mode 21
27	B/PB2048	Simultaneously recording Serial B data and dumping per mode 17
28	B/PB1024	Simultaneously recording Serial B data and dumping per mode 18
29	B/PB960	Simultaneously recording Serial B data and dumping per mode 19
30	B/PB192	Simultaneously recording Serial B data and dumping per mode 20
31	B/PB128	Simultaneously recording Serial B data and dumping per mode 21
32	P/PB2048	Simultaneously recording per mode 5 and dumping per mode 17
33	P/PB1024	Simultaneously recording per mode 5 and dumping per mode 18
34	P/PB960	Simultaneously recording per mode 5 and dumping per mode 19
35	P/PB192	Simultaneously recording per mode 5 and dumping per mode 20
36	P/PB128	Simultaneously recording per mode 5 and dumping per mode 21
37	E/PB2048	Simultaneously recording per mode 4 and dumping per mode 17
38	E/PB1024	Simultaneously recording per mode 4 and dumping per mode 18
39	E/PB960	Simultaneously recording per mode 4 and dumping per mode 19
40	E/PB192	Simultaneously recording per mode 4 and dumping per mode 20
41	E/PB128	Simultaneously recording per mode 4 and dumping per mode 21
42	ERASE	Erasing all non-volatile memory (NVM) (maintenance function)
43	REMAP	Destructive remapping of NVM to exclude bad segments (maintenance function)
44	TEST	Non-destructive in-depth self-testing (maintenance function)
45	POST	Power-on self-test mode
>45	INVAL	Values of 46 through 63 are invalid

	SSR 1	SSR 2
<b>Location</b>	Av Bay 1 Shelf 2 MF43G	Av Bay 2 Shelf 2 MF57G
<b>Cooling</b>	Water Loops	Water Loops
<b>Power</b>	CNTL AB1 MNA FPC1 O14	CNTL AB2 MNB FPC2 O15

**TITLE**

OEX/OARE COMMAND PLAN

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**CONSTRAINTS**

All commands in this procedure are real-time commands and are approved for any OPS mode.

**PURPOSE**

To define the command plan for Orbiter Experiments (OEX) and Orbital Acceleration Research Experiment (OARE). Record data on a copy of this procedure (not in the CHB).

**GENERAL**

OEX/OARE hardware is unique to OV-102 only. OARE is seldom manifested on a mission; OARE procedures are highlighted in gray. When applicable, this data will be recorded during ascent, deorbit, entry, and post landing. If batteries are not installed in the SCM, INST will have to perform steps highlighted in reverse.

**Useful Names and Telephone Numbers**

Name	Office	Home
<b>OEX Recorder</b>		
Rey Rivas	281-853-1618	281-334-1133
John Miller	281-483-6908	281-471-4393
Dwight Favors	281-483-5458	281-484-7473
<b>CONSOLE</b>		
INST	281-483-3458	

**NOTATION AND STRUCTURE**

All nominal procedures are referenced by a number.

Example: **2**

All contingency procedures are referenced by a  $\Delta$  followed by a number.

Example:  **$\Delta$  1**

The approximate mission elapsed time (MET) and phase elapsed time (PET) are displayed for each procedure (bold characters), near the left hand margin.

Example: **12/05:35** (MET)  
**At EI - 10** (PET)

There is a Mark Quick Reference appendix that may be used to record the mark locations if the user desires. There is an appendix that contains the predicted locations for all of the data takes.



Some contingency procedures require the crew to turn the MASTER OEX POWER switch OFF, which turns off the SCM and terminates this procedure.

**ASCENT PHASE**

**T -3:00 hours**

S0007VL2 Seq. 16 OARE Activation

There are no commanding steps in this sequence.

S0007VL2 Seq. 16 OARE Recording Activation

OARE is recorded on the E1 region of SSR 1 in the Record Parallel mode. Since the SSR "packs" OARE "snapshot" data, the E1 region of SSR1 can record over four days of OARE data.

DSM	Title	√
9202	SSR1 RCDP	
7004	OARE QUIET MODE OFF	
7001	OARE RECORD READY ON	

If the PL (tape) recorder is used, the following procedure is used:

DSM	Title	√
4501	P/L TRACK 1 - SEL	
4526	P/L SPEED 1 - SEL	
4516	P/L RCD SERIAL B (unsafe)	
7004	OARE QUIET MODE OFF	
7001	OARE RECORD READY ON	

OARE record data rate is 32 Kbps at 6 IPS on the P/L recorder.

**T -12** S0007VL2 Seq. 16  
Kick off to S0007VL4 Seq. 38

**1** OEX Activation:

If no batteries in the SCM, record current % tape \_\_\_\_\_ %  
Expected tape value should be less than 15% per agreement with KSC.  
If no batteries in the SCM, % tape telemetry may read 0% or 99%, which is okay.  
If no batteries in the SCM, SCM Echo may not display the nominal FA value. Contact Dwight  
Favors if the value is FB.

The following commands should be sent at L-22 but if problems occur, they can be sent as late as *BUT NO LATER THAN* L-15.

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5704	SCM DECIMAL 4	04	
5736	SCM ENTER	99	

VERIFY: track = 28, RCD mode, speed = 15 IPS and motion = RUN (approximately 2 minutes after the ENTER command).

**T - 9** S0007VL4 Seq. 38  
**2** OEX Ascent Configuration

**WARNING:** Do NOT initiate Label 2 before the recorder is observed to have stopped (Last step in label 4)!

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5702	SCM DECIMAL 2	02	
5736	SCM ENTER	99	

VERIFY: track = 28, RCD mode, speed = 15 IPS and motion = RUN (approximately 2 minutes after the ENTER command).

**MECO + 6**

**3 OEX Recorder Power Down**

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5715	SCM DECIMAL 15	0F	
5736	SCM ENTER	99	

VERIFY: AUTOCAL ON. One minute later the recorder will be powered down and all inputs to the SCM deactivated except the manual command port.

Record current % tape. \_\_\_\_\_%  
This will be used for step 4.

**MECO + 10**

**4 Rewind recorder for entry; perform this step before Master OEX power is turned off.**

The OEX Recorder must be rewound to

\_\_\_\_\_ % = Step 3 \_\_\_\_\_ % - 21

*Example: If the % tape after step 3 was 28 % then  
7 % = 28 % - 21  
So the OEX recorder would need to be positioned to 7 % for the deorbit burn.*

DSM	Title	ECHO	√
5744	SCM DIR REVERSE	A4	
5747	SCM SPEED	A8	
5707	SCM DECIMAL 7	07	
5736	SCM ENTER	99	

VERIFY: The percent tape is incrementing at 60 IPS. (The speed command will set the tape transport mechanism in motion at the speed specified, regardless of whether or not the recorder power discrete has been specifically set.)

When the OEX recorder has reached calculated % tape send the following commands to stop the motion:

DSM	Title	ECHO	√
5766	SCM ALL STOP	AE	
5736	SCM ENTER	99	

VERIFY: The record motion is stopped. (It is OK for the recorder to go 1 more % tape as long as the commands were sent at the calculated % tape.)

Wait 10 seconds then:

5743	SCM DIR FORWARD	A2	
5736	SCM ENTER	99	

VERIFY: Tape Direction = FWD. (This DIR FORWARD command sets the tape transport mechanism to pull tape in the forward direction for entry, but it does not apply power to the recorder or cause tape motion.)

Record % tape \_\_\_\_\_%

**ORBIT PHASE**

There are no planned data takes for the OEX during the orbit phase.

OARE will be operated and its data recorded on SSR1 or the PLR and dumped per the flight specific plan.

**OARE DUMP**

Once the SSME data has been dumped the OARE ascent data should be dumped through the Ku band system.

**For SSR1, GCMR:** Ku channel 2 to 960 Bi-Phase L OARE data

When COMMAND reports the GCMR active and DFE reports that the customers are ready:

DSM	Title	√
4136	Ku LDR -MMU1	
9252	SSR1 HALT	
9210	SSR1 PB ME 960	

SSR1 will revert to STBY mode when all data is dumped.

Dumped from position 0 to position \_\_\_\_\_

**For PLR, GCMR:** Ku channel 2 to 640 Bi-Phase L OARE data

When COMMAND reports the GCMR active and DFE reports that the customers are ready:

DSM	Title	√
4132	Ku LDR -PL RCDR	
4551	PLR STOP	
4529	PLR SPEED 4 - SEL	
4517	PLR PLBK SERIAL	
4551	PLR STOP	

Dumped from track \_\_\_\_\_% to track \_\_\_\_\_%

**ENTRY PHASE**

If no batteries in the SCM, record current % tape \_\_\_\_\_ %

**5 De-orbit Burn**

**At TIG - 40 min.**

Record OARE per flight specific plan (SSR or PLR).

DSM	Title	√
7005	OARE RE-ENTRY MODE ON	

To save room in the SPC buffer these commands should be sent real time.

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5722	SCM DECIMAL 22	16	
5736	SCM ENTER	99	

VERIFY: track = 15

At "SCM ENTER" of label 22 + 29 minutes (approximately TIG -11), the label will power the recorder. The PCM BITES should disappear

Approximately one minute later, verify track 27, mode RCD, speed 15 IPS, and motion RUN.

**6 Entry Interface (EI)**

It is best to have these commands put in the SPC buffer, prior to TIG, to guarantee that they will execute at EI -10 (check for prebuilt commands). Include a 5 second delay between each command in the SPC buffer so you can verify that the SCM echoes the commands correctly. If the burn did not occur, clear the SPC buffer and continue to follow the contingency procedures (STEP # Δ8). EI + 23 minutes PCM number 3 will turn ON. Verify PCM number 3 is ON per your console. Then 2 minutes later the label 22 will end. This must occur before the following commands execute.

**At EI - 10 min.**

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5727	SCM DECIMAL 27	1B	
5736	SCM ENTER	99	

VERIFY: The recorder will momentarily stop and track 27 will be displayed. 5 minutes later track 28 will be displayed. This label also power cycles the wing loads data.

**POST-LANDING TIME FRAME**

7 Wheel Stop

If no batteries in the SCM, record current % tape \_\_\_\_\_ %

At wheel stop + 2 min.

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5728	SCM DECIMAL 28	1C	
5736	SCM ENTER	99	

This label will do an auto calibration and then power down. At wheel stop + 8 the recorder will power back up and go into snapshot mode at 7.5 IPS a minute later. The recorder will continue to operate for another 134 minutes.

If indicated by flight-specific OARE plan, leave the SSR1 or PLR recording OARE until time to dump it (after dumping the OD)

For SSR1, tell DFE to set up for 960 OARE dump

DSM	Title	√
4728	FM -MMU1	
9252	SSR1 HALT	
9210	SSR1 PB ME 960	

SSR1 will revert to STBY mode when all data is dumped.

Dumped from position 0 to position \_\_\_\_\_

For PLR, tell DFE to set up for 640 OARE dump

DSM	Title	√
4786	FM -PL RCDR	
4551	PLR STOP	
4529	PLR SPEED 4 - SEL	
4517	PLR PLBK SERIAL	
4551	PLR STOP	

Dumped from track \_\_\_\_\_ % to track \_\_\_\_\_ %

**CONTINGENCY PLANS**

**Δ1 Launch Scrub after L -22** (but before T - 9)

Note the percent tape used.

\_\_\_\_\_ % tape

DSM	Title	ECHO	√
5766	SCM ALL STOP	AE	
5736	SCM ENTER	99	

Verify that the recorder has been powered down!

**Δ2 Launch Hold after L -22** (but before T - 9 and counting)

Let label #4 time out (approximately 4 minutes after commanded) then note the percent tape used.

\_\_\_\_\_ % tape

If the hold has been longer than 30 minutes:

DSM	Title	ECHO	√
5766	SCM ALL STOP	AE	
5736	SCM ENTER	99	

If "GO FOR LAUNCH" is before T - 14:

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5704	SCM DECIMAL 4	04	
5736	SCM ENTER	99	

VERIFY: track = 28, RCD mode, speed = 15 IPS and motion = RUN (approximately 2 minutes after the ENTER command). The recorder tape motion will stop approximately 4 minutes after the ENTER command.

**GO TO STEP 2** for the nominal T -9 actions.

Else if "GO FOR LAUNCH" is later than T - 14:

**At T - 9** (Out of the T -9 hold):

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5703	SCM DECIMAL 3	03	
5736	SCM ENTER	99	

Wait 1 minute then:

DSM	Title	ECHO	√
5740	SCM DISCRETE ON	86	
5726	SCM DECIMAL 26	1A	
5736	SCM ENTER	99	

**GO TO STEP 3** for the nominal MECO + 6 minute actions.

NOTE: Label #3 does not turn on the wing loads sensors so the discrete on command is used to turn the sensors on.

**Δ3 Launch Hold after T - 9**

Wait until label #2 times out (approximately 2 minutes) then:

DSM	Title	ECHO	√
5747	SCM SPEED	A8	
5701	SCM DECIMAL 1	01	
5736	SCM ENTER	99	

VERIFY: No motion on the recorder.

If out of the hold and it was less than 30 minutes then:

DSM	Title	ECHO	√
5747	SCM SPEED	A8	
5705	SCM DECIMAL 5	05	
5736	SCM ENTER	99	

**GO TO STEP 3** for the nominal MECO + 6 minute actions.

If hold has been longer than 30 minutes note percent tape used then:

\_\_\_\_\_ % tape

DSM	Title	ECHO	√
5746	SCM RECORD STOP	A6	
5736	SCM ENTER	99	

**CAUTION:** Don't continue until motion is stopped!

5741	SCM DISCRETE OFF	84	
5732	SCM DECIMAL 32	20	
5736	SCM ENTER	99	

This sequence of commands will power off the recorder. This is necessary to allow the recorder to cool off.

After the hold is released:

DSM	Title	ECHO	√
5740	SCM DISCRETE ON	86	
5732	SCM DECIMAL 32	20	
5736	SCM ENTER	99	

**CAUTION:** Wait at least 5 seconds before continuing!

5747	SCM SPEED	A8	
5705	SCM DECIMAL 5	05	
5745	SCM RECORD	B2	
5736	SCM ENTER	99	

**GO TO STEP 3** for the nominal MECO + 6 minute actions.

**Δ4 Launch Scrub after T -9**

Note the percent tape used.

\_\_\_\_\_ % tape

DSM	Title	ECHO	√
5766	SCM ALL STOP	AE	
5736	SCM ENTER	99	

**Δ5 RTLS ABORT or TAL**

At wheel stop + 15 min.:

DSM	Title	ECHO	√
5760	SCM CONT. AT LABEL	91	
5715	SCM DECIMAL 15	0F	
5736	SCM ENTER	99	

This is the nominal power down label.

A Flight Note will be required to power off the MADS system.

**Δ6 ATO**

Follow the nominal plan.

**Δ7 AOA**

- A. If AOA is announced before step 3 is initiated:

At MECO + 6 min.

DSM	Title	ECHO	√
5747	SCM SPEED	A8	
5701	SCM DECIMAL 1	01	
5741	SCM DISCRETE OFF	84	
5726	SCM DECIMAL 26	1A	
5736	SCM ENTER	99	

VERIFY: No motion, speed = 0 and MADS PCM #3 is off

Build an MSPC for nominal step 6.

At TIG - 5 min.

DSM	Title	ECHO	√
5747	SCM SPEED	A8	
5705	SCM DECIMAL 5	05	
5736	SCM ENTER	99	

VERIFY: RCD mode, speed = 15 IPS and motion = RUN

**GO TO STEP 7** for the nominal post wheel stop actions.

- B. If AOA is announced after nominal step 3 is performed, but before step 4 is initiated:

Build an MSPC for nominal step 6.

Execute the following to capture the Deorbit burn:

DSM	Title	ECHO	√
5740	SCM DISCRETE ON	86	
5732	SCM DECIMAL 32	20	
5736	SCM ENTER	99	

**CAUTION:** Wait at least 5 seconds before continuing!

5747	SCM SPEED	A8	
5705	SCM DECIMAL 5	05	
5745	SCM RECORD	B2	



At TIG - 5 min.

DSM	Title	ECHO	√
5736	SCM ENTER	99	

VERIFY: RCD mode, speed = 15 IPS and motion = RUN

**GO TO STEP 7** for the nominal post wheel stop actions.

C. If AOA is announced after nominal step 4 is commenced, finish it as soon as possible, then:

Build an MSPC for nominal step 6.

**NOTE:** If the actual tape used (♣) at deorbit burn TIG + 5 is 46 % or higher, stop the tape for (♠) minutes using the following formula:

$$\spadesuit = 1.26 * (\clubsuit - 46)$$

Example: at TIG + 5 min. the % tape used = 49  
 $\spadesuit = 1.26 * (49 - 46) = 4$  minutes

To stop the recorder motion:

DSM	Title	ECHO	√
5747	SCM SPEED	A8	
5701	SCM DECIMAL 1	01	
5736	SCM ENTER	99	

**CAUTION:** Wait at least 5 seconds before continuing!

VERIFY: No motion on the recorder.

After ♠ minutes:

DSM	Title	ECHO	√
5747	SCM SPEED	A8	
5705	SCM DECIMAL 5	05	
5736	SCM ENTER	99	

**CAUTION:** Wait at least 5 seconds before continuing!

**GO TO STEP 7** for the nominal post wheel stop actions.

**Δ8 Entry Wave Off** (one revolution or more)

If wave off is before step 5 there are no actions.

If wave off is after step 5:

1. Be sure to clear the MSPC that was built for step 5 and 6.
2. As soon as the wave off is called note the percent tape.
3. Then do the following:

\_\_\_\_\_ % tape

DSM	Title	ECHO	√
5766	SCM ALL STOP	AE	
5736	SCM ENTER	99	

**CAUTION:** Wait at least 5 seconds before continuing!

4. **GO TO STEP 5** for the next deorbit burn attempt.

If wave off is for the next day, return to the nominal command plan for entry data takes.

**NOTE:** If at some point after label #22 has been initiated, a wave off is declared, the command link is down, and actual percent tape is > 36%. Then once command is recovered:  
Rewind the tape to 36% to insure that an adequate amount of unrecorded tape is available for the entry data. This data is much more important than the deorbit burn data.

DSM	Title	ECHO	√
5744	SCM DIR REVERSE	A4	
5747	SCM SPEED	A8	
5707	SCM DECIMAL 7	07	
5736	SCM ENTER	99	

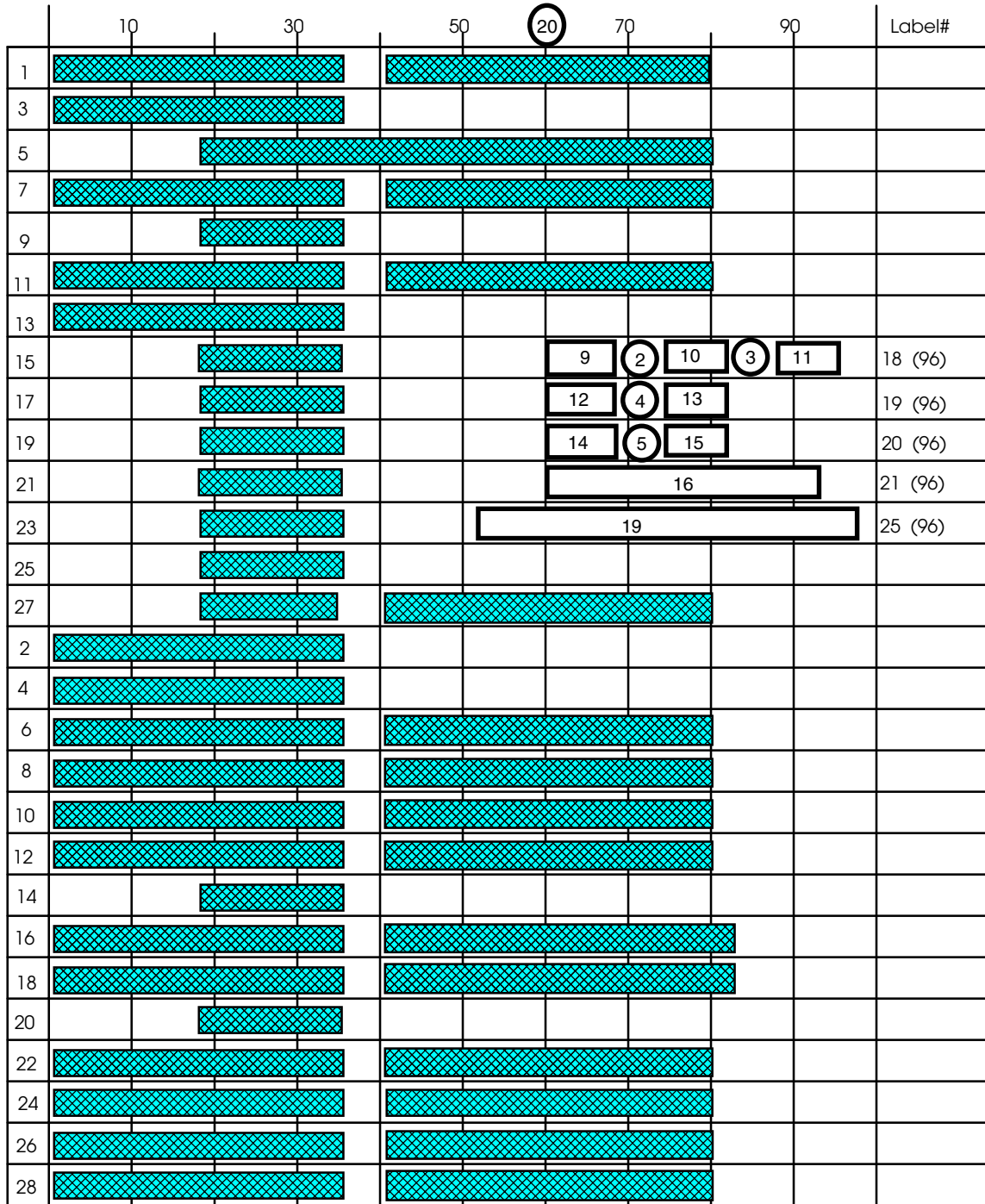
VERIFY: The percent tape is incrementing at 60 IPS.

When the OEX recorder has reached 37%, send the following commands to stop the motion:

DSM	Title	ECHO	√
5766	SCM ALL STOP	AE	
5736	SCM ENTER	99	

VERIFY: The record motion is stopped.

**If no batteries in the SCM, record current % tape \_\_\_\_\_%**



= USED for ascent or entry data

( ) = minutes available at the label's defined record speed



= Step location references (predicted)



= Mark location (predicted)

**TITLE**

ORBITER INTERFACE UNIT (OIU) ACTIVATION/ DEACTIVATION

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

This procedure will provide the standard steps required for OIU activation and deactivation.

**RESTRICTIONS & CONSTRAINTS**

These procedures are valid in all ops modes of the GNC, SM and the BFS major functions. Crew coordination is required for OIU power control.

**A. OIU Activation**

1. Load PCMMU and PDI for OIU default mode (OIU FMT 255 - health and status only).

Note: If configuration downlinks two different OIU DFLs, DFE will need to select the 1<sup>st</sup> or 2<sup>nd</sup> occurrence appropriately.

SKIP NEXT STEP IF THE CORRECT PSP IS ALREADY POWERED (PSP 1 required for OIU 1, PSP 2 required for OIU 2).

2. Power on PSP 1 (2):

PL PSP - SEL (DSM 4803)

PL SYSTEM 1 (2) - ON (DSM 4800 [4802])

Perform a PSP 1 (2) I/O Reset (DSM 12547[12548]).

3. Load PSP configuration for OIU commanding:

DSM 133XX PSP Dummy for OIU

4. Request crew to power on OIU 1 (2).

SSP 1 OIU - OIU 1 (1) ON tb UP (DN)

5. Command OIU to update time with the current year - 1

DSM 133XX OIU UPDATE YEAR xxxx

Updating the OIUs with a different year will allow for differentiation between OIUs in ODRC telemetry.

6. Evaluate OIU telemetry (request MER to evaluate OIU telemetry as well).

- a. Notice if PTB read was successful by evaluating OIU time and OIU PTB H&S errors. If read was unsuccessful, OIU time will be set to its default value of 01/00/00/00 and not

the current orbiter GMT. The PTB NOT AVAILABLE error (P50X4308E) will also be set if read was unsuccessful.

- b. Evaluate PSP-OIU interface by verifying that an idle pattern is being received by the OIU. If PSP configured correctly, the PSP SIGNAL(P50X4283E) flag should not be set. In addition, verify that the command counter incremented to a value of 1 and that the command to update the year was successful.
- c. Verify format ID is 255, and temperature for the active OIU is in the range of 80° to 120°.

The following checkout steps are required only in the event of an anomaly.

7. Command OIU to ERROR LOG DUMP format (FMT 254).

DSM 133XX OIU FMT 254

8. Load PCMMU and PDI for OIU ERROR LOG DUMP configuration.

Note: If configuration downlinks two different OIU DFLs, DFE will need to select the 1<sup>st</sup> or 2<sup>nd</sup> occurrence appropriately.

9. Evaluate OIU telemetry and ERROR LOG dump.

- a. The MER is responsible for evaluating the ERROR LOG dump. The error log, which is repeatedly dumped in format 255, consists of 1612 bytes and takes approximately 2 seconds to dump.
- b. Evaluate OIU telemetry by verifying that OIU format ID is 254 and command counter is incremented to a value of 2.

Repeat steps 1-9 for other OIU if required.

## B. OIU deactivation

Note: **Verify that ISS operations are complete.**

Possible "S62 PDI DECOM FAIL" message

1. Have crew power off the OIU.  
SSP 1 OIU - center position, tb - BP
2. Load PCMMU and PDI as required.

**TITLE**

ORBITER INTERFACE UNIT (OIU) CONFIGURATION CONTROL

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

**PURPOSE**

This procedure provides the standard steps required for all aspects of OIU configuration control.

**RESTRICTIONS & CONSTRAINTS**

These procedures are only valid in all ops modes of the SM major function. Some steps may be time critical to minimize the loss of ISS telemetry. Crew action is required only for powering on/off or swapping between OIUs.

**GENERAL**

OIU configuration commands are used for time updates, bus configurations, command rerouting, and changes to physical device data and to load the OIU format.

All OIU configuration commands are Payload Data Loads (PDLs). Each command can be built using the General Payload Load Build menu on the Generic Command Server (GCS) Inst Command Build application. SCP 3.38 define the standard procedure to build a PDL for the GCS. The contents (HEX data words) for each configuration command, except composite commands, are defined in the Command and Data (C&D) Annex. The structure of the configuration commands is defined in the OIU System Brief.

**PROCEDURE**

A. OIU Format Load

The OIU format simply determines what and how Space Station Element telemetry is processed. The formats are Flight Re-configurable (RECON) products and, therefore, are mission dependent. Each format defines which logical devices are active and defines the structure of the telemetry stream. All formats include OIU Health and Status (H&S) information.

Figure 3.33-1 gives an example of the HEX data words defined in the C&D Annex for an OIU format load and defines the structure of the command

← Command Words 1-64 ⇒

0008 1401 1901 1901 00E2

Nomenclature

OIU FMT 1

Preamble	Byte Count	CMD Type	No. of Subtypes to Follow
0000 0000	0000 1000	0001 0100	0000 0001
00h	08h	14h	01h

Subtype	OIU FMT No.	Unused*	Unused*
0001 1001	0000 0001	0001 1001	0000 0001
19h	01h	19h	01h

Routing Code	Parity Byte
0000 0000	1110 0010
00h	E2h

\*Unused bits are "don't cares" and can be set to any value; however, changing them requires a new parity byte calculation.

**Figure 3.33-1. OIU format configuration command structure**

B. Assigning a Physical Device (PD) to a Logical Device (LD)

A logical device is a type of MS1553B On-Orbit Replaceable Unit (ORU) that communicates with the OIU. The Alpha Magnetic Spectrometer (AMS) computer; Mini Pressurized Logistics Module (MPLM) MDM; Russian Functional Cargo Block (FGB); Node MDM; and Guidance, Navigation, and Control (GNC) MDM are all examples of logical devices.

Logical device data tell the OIU how to communicate with a particular type of MS1553B ORU. However, the OIU must know which physical device is mapped to the logical device in order to collect telemetry and route commands to the device. For example, assume the FGB is an active device in the current OIU format. There are two FGB MDMs, a prime and a backup. Each MDM is physically located on an MS1553B bus at different RT addresses. While these two devices look the same to the OIU (both are represented by the same logical device), only one at a time is active and talking to the OIU.

When more than one physical device is represented by a single logical device, as in the example of the two FGB MDMs, only one physical device is mapped to a logical device at any given time. The OIU communicates with that physical device to process its telemetry and to route its commands. If the OIU is required to communicate with both the prime and backup devices simultaneously, two logical devices, one for each physical device, must be defined.

Figure 3.33-2 gives an example of the HEX data words defined in the C&D Annex for a PD to LD mapping load and defines the structure of the command.

⇐ Command Words 1-64 ⇒

0008 1401 1705 0A0A 00F0

Nomenclature

OIU LD FGB ⇒ PD FGB2

Preamble	Byte Count	CMD Type	No. of Subtypes to
0000 0000	0000 1000	0001 0100	0000 0001
00h	08h	14h	01h

Subtype	LD ID No.	PD ID No.	Unused*
0001 0111	0000 0101	0000 1010	0000 1010
17h	05h	0Ah	0Ah

Routing Code	Parity Byte
0000 0000	1111 0000
00h	F0h

LD ID No.:  
1-35

PD ID No.:  
1-50

\*Unused bits are "don't cares" and can be set to any value; however, changing them requires a new parity byte calculation.

**Figure 3.33-2. OIU PD to LD mapping configuration command structure**

C. BC/Remote Terminal (RT) and Channel A/B Configuration

The OIU supports four MS1553B hardline buses. The OIU can be configured so that it operates either as a BC or as a RT on that bus. However, only one bus can be configured as RT at a time because of limitations in the ability of the OIU to sync to more than one BC.

When configured as a BC, the OIU schedules bus traffic and actively requests data from the device, and when configured as an RT, the OIU waits for another device on the MS1553B bus to supply the data. In addition, if the OIU is a BC on the bus, the bus configuration data inform the OIU which channel (A/B) to use as the primary channel for communicating with physical devices on that bus.

Figure 3.33-3 gives an example of the HEX data words defined in the C&D Annex for a channel change load and defines the structure of the command.

⇐ Command Words 1-64 ⇒

0008 1401 1510 FEAD 00B4

Nomenclature

OIU Channel A Bus 1



Preamble	Byte Count	CMD Type	No. of Subtypes To Follow
0000 0000	0000 1000	0001 0100	0000 0001
00h	08h	14h	01h

Subtype	Bus No.	CH	BC/RT Flag	Unused*
0001 0101	0001	0000	1111	1110 1010 1101
15h	1h	0h	Fh	EADh

Routing Code	Parity Byte
0000 0000	1011 0100
00h	B4h

Bus No.:  
1-4

Channel:  
0 = A  
1 = B  
'1111'B = No change

BC/RT Flag:  
0 = OIU is RT  
1 = OIU is BC  
'1111'B = No change

\*Unused bits are "don't cares" and can be set to any value; however, changing them requires a new parity byte calculation.

**Figure 3.33-3. OIU channel or BC/RT configuration command structure**

D. PD Bus or RT Address Change

This type of command is used to map a PD to a new bus or new RT address that is different from the mapping specified in the reconfiguration table. These changes remain in effect until the OIU is power cycled or commanded to return to original mapping. This type of command is useful for checkout or troubleshooting purposes if a physical device interfaces with the OIU on more than one bus.

Figure 3.33-4 gives an example of the HEX data words defined in the C&D Annex for a PD bus change load and defines the structure of the command.

⇐ Command Words 1-64 ⇒

0008 160A F4FF 00F5

Nomenclature

OIU FGB2 on BUS 4

Preamble	Byte Count	CMD Type	No. of Subtypes to Follow
0000 0000	0000 1000	0001 0100	0000 0001
00h	08h	14h	01h

Subtype	PD ID No.	Unused*	Bus No.	RT Address
0001 0110	0000 1010	1111	0100	1111 1111
16h	0Ah	Fh	4h	FFh

Routing Code	Parity Byte
0000 0000	1111 0101
00h	F5h

PD ID No.:                      Bus No.:                      RT Address:  
 0-50                              1-4 or                          0-30 or  
    '1111'B = No change    '1111'B = No change

\*Unused bits are "don't cares" and can be set to any value; however, changing them requires a new parity byte calculation.

**Figure 3.33-4. OIU PD bus or RT address configuration command structure**

E. Reroute Commands

This command type can be used to route commands with a given destination to a destination specified by another routing code. For example, this command can cause the OIU to route commands with a routing code of FGB MDM to the N1 MDM. There are no plans to use this type of configuration command, and, therefore, none have been pre-built.

F. Composite Commands

Composite commands contain multiple configuration commands and eliminate any awkward or nonessential configuration. The commands discussed in steps A-E above are the only subtype commands that can be combined to form a composite command. Composite commands are processed in series and all commands are implemented before the OIU returns to normal command processing.

Data words for a composite command are not included in the C&D Annex. To build a composite command, the subtype data words defined in the C&D Annex will be combined in the following manner:

To build a composite command to configure: Bus no. 3 to BC mode  
 Bus no. 4 to RT mode  
 Map PD N1-2 to LD N1  
 Load OIU FMT 2

1. First define the data words located in the C&D Annex for the subtype commands.

<u>⇐ Command Words 1-64 ⇒</u>	<u>Nomenclature</u>
0008 1401 153F 1919 00C8	OIU BC on bus 3
0008 1401 154F 0F0F 00B8	OIU RT on bus 4
0008 1401 1704 0825 00DC	OIU LD N1 = N1-2
0008 1401 1902 1902 00E2	OIU FMT 2

2. Determine number of subtypes to follow:

Number of subtypes to follow = Number of subtype commands to combine  
= 4

3. Calculate byte count:

Byte count = (number of subtype commands \* 4) + 4  
= (4 subtypes \* 4) + 4  
= 14h

4. Truncate the preamble, byte count, CMD type, number of subtypes to follow, routing code, and parity byte from each of the subtype data words defined in the C&D Annex.

<u>Nomenclature</u>	<u>⇐ Command Words 1-64 ⇒</u>	<u>Truncated to</u>
OIU BC on bus 3	0008 1401 <u>153F 1919</u> 00C8	153F 1919
OIU RT on bus 4	0008 1401 <u>154F 0F0F</u> 00B8	154F 0F0F
OIU LD N1 = N1-2	0008 1401 <u>1704 0825</u> 00DC	1704 0825
OIU FMT 2	0008 1401 <u>1902 1902</u> 00E2	1902 1902

5. Combine the above results using the following format:

00 xx 14 yy aaaaaaaaa bbbbbbbb cccccccc dddddddd 00pp

where xx = byte count

yy = no. of subtypes to follow

aaaaaaaa = truncated subtype 1 data words

bbbbbbbb = truncated subtype 2 data words

cccccccc = truncated subtype 3 data words

ddddddd = truncated subtype 4 data words

pp = parity byte

Composite command = 0014 1404 153F 1919 154F 0F0F 1704 0825 1902 1902 00pp

6. To calculate parity byte, Exclusive Or ( $\oplus$ ) all bytes, except routing code together with FFh:

00h  $\oplus$  14h  $\oplus$  14h  $\oplus$  04h  $\oplus$  15h  $\oplus$  3Fh  $\oplus$  19h  $\oplus$  19h  $\oplus$  15h  $\oplus$  4Fh  $\oplus$  0Fh  $\oplus$  0Fh  $\oplus$  17h  $\oplus$  04h  $\oplus$  08h  $\oplus$  25h  $\oplus$  19h  $\oplus$  02h  $\oplus$  19h  $\oplus$  02h  $\oplus$  FFh = B5h

After parity byte is calculated, HEX data words for the composite command are complete:

0014 1404 153F 1919 154F 0F0F 1704 0825 1902 1902 00B5

Figure 3.33-5 illustrates the completed HEX data words for a composite command and defines the structure of the command.

Preamble	Byte Count	CMD Type	No. of Subtypes to Follow
0000 0000	0001 0100	0001 0100	0000 0004
00h	14h(20 Bytes)	14h	04h

Subtype	Bus No.	CH	BC/RT	Unused*
0001 0101	0011	1111	0001	1001 0001 1001
15h	3h	Fh	1h	919h

Subtype	Bus No.	CH	BC/RT	Unused*
0001 0101	0100	1111	0000	1111 0000 1111
15h	4h	Fh	0h	F0Fh

Subtype	LD ID No.	PD ID No.	Unused*
0001 0111	0000 0100	0000 1000	0010 0101
17h	04h	08h	25h

Subtype	OIU Format No.	Unused*
0001 1001	No.	0001 1001 0000 0010
19h	02h	1902h

Routing Code	Parity Byte
0000 0000	1011 0101
00h	B5h

\*Unused bits are "don't cares" and can be set to any value; however, changing them requires a new parity byte calculation.

**Figure 3.33-5. OIU N1-2 PRI composite configuration command structure**

G. Payload Timing Buffer (PTB) Updates

As part of the application initialization, the OIU allows 2.5 seconds to read the PTB time. If the PTB read is successful, the internal time will be set to the PTB time. If PTB time cannot be acquired within 2.5 seconds, there are two possible actions:

1. If the OIU is processing a power on application initialization, OIU internal time is set to a default value 1/0/0/0/0 (dd/hh/mm/ss/μμ).
2. If application initialization is occurring for some reason other than a power on (e.g., configuration commands or a sync loss), internal time retains its current value.

H. Node MDM Diagnostic Dump Procedures

OIU Format 250 and 251 are used to support diagnostic dumps of the Node MDMs. Format 250

supports a dump of the MDM memory map, while Format 251 supports a dump of the MDM BIT Summary Tables. After the OIU is configured by INST, ODIN performs the appropriate load and/or dump, coordinating with ISS GC/DFE/COMMAND to capture a delog of the dump.

1. ODIN ensures that the MDM command load is properly built; ODIN contacts COMMAND to configure the ISS command server to send a load to a diagnostic MDM.
2. ODIN contacts INCO on INCO loop to request configuring the OIU for format 250 or 251 with the relevant Node MDM.
3. INST uplinks the prebuilt composite command for the appropriate MDM and appropriate format.
4. INST configures the PCMMU and PDI appropriately for diagnostic data.
5. NCO contacts ODIN on the ODIN loop when the configuration is complete.
6. ODIN coordinates with ISS GC/DFE/COMMAND to prepare for the dump.
7. ODIN then uplinks the appropriate initiating command, with FD GO.
8. ODIN determines when a dump is complete and contacts ISS GC/DFE to terminate the dump configuration.
9. ODIN reports the results of the dump to ISS FD.
10. ODIN contacts COMMAND and INCO, when appropriate, to restore the nominal commanding and telemetry configurations

## TITLE

ORBITER INTERFACE UNIT (OIU) TO SPACE TO SPACE ORBITER RADIO (SSOR) ENCRYPTION KEY SELECTION COMMANDS

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

## PURPOSE

This procedure provides the standard steps required for building the commands needed to select specific encryption keys for the SSOR.

## RESTRICTIONS & CONSTRAINTS

These procedures are only valid in all ops modes of the SM major function. Some steps may be time critical to minimize the loss of ISS telemetry. Crew action is required only for powering on/off or swapping between OIUs.

Time constraints, crew coordination requirements: Some steps may be time critical to minimize the loss of ISS telemetry. Crew action is required only for powering on/off or swapping between OIUs.

## GENERAL

These OIU commands are used to configure the SSOR to support a specific encryption key. The SSOR has 4096 different encryption keys preloaded. CATO and INCO have decided to assign the first 100 encryption keys to be used for SSOR/Space to Space Station Radio (SSSR) communications. Encryption keys #0 and #11 are test keys. Encryption key #11 is the default key when the SSOR encryption switch is taken to ON by the crew (O6 UHF ENCRYPT –ON).

For each mission, INCO and CATO will determine how many encryption keys may be required to support the mission and will agree which keys to use. The number of keys will be the minimum required + 2 contingencies. CATO will maintain a log of all SSSS encryption keys available for use and that have already been used. Each key can only be used once.

A new SSOR key command must be uplinked each time the SSOR is powered up with encryption on to communicate with the SSSR. Most of the time SSSR keys will be sent to the SSSR via the ISS S-Band link. If that link is not available, the SSSR key commands can be sent via the OIU and SSOR, but the SSSR key command must be changed before the SSOR key command in order to avoid a key mismatch.

All OIU to SSOR commands are Payload Data Loads (PDLs). Each command can be built using the General Payload Load Build menu on the Generic Command Server (GCS) Inst Command Build application. SCP 3.38 defines the standard procedure to build a PDL for the GCS. The structure of the OIU commands is defined in the OIU System Brief.

## PROCEDURE

The SSOR key commands tell the SSOR which encryption key to use. This key must match the key that is selected in the SSSR. The routing code for OIU to SSOR commands is 03hex(h). The SSOR can receive a command with up to 64 command words, but since words 2-64 are not used (fill data), only command word 1 is required in the OIU SSOR key command. Figures 3.34-1 and 3.34-2 give examples of the HEX data words needed for two SSOR key commands and define the structure of each command.

Note that bit 0 is the LSB and bit 15 is the MSB.

Command Words  
0004 000B 03F3

Nomenclature  
SSOR KEY 11

To calculate parity byte (Key 11), Exclusive Or ( $\oplus$ ) all bytes with FFh: 00h  $\oplus$  04h  $\oplus$  00h  $\oplus$  0Bh  $\oplus$  03h  $\oplus$  FFh = F3h

Preamble	Byte Count	SSOR key #	Routing Code	Parity Byte
0000 0000	0000 0100	0000 0000 0000 1011	0000 0011	1111 0011
00h	04h	000Bh	03h	F3h

The screenshot shows the 'Orbiter Gen Payload Build v1.2' application window. At the top, it displays 'GMT: 074:09:10:36' and 'F/V: 102/103'. Below the title bar, there is a menu bar with 'File', 'CMD Type', 'Operation', and 'Help'. The main interface includes a 'Gen Payload' field with the value '13301', a 'Title' field with 'SSOR KEY 11', and a 'GMT GEN:' field. Below these, there is a table for 'Orbiter OP Code' and 'Two Stage' values, with a 'Payload Dest' dropdown set to 'PSP' and a 'Dest Dep ID' field set to '1'. The table lists 12 rows of data, with the first row containing the values 03, 0004, 13, 22, 31, 40, 49, and 58. At the bottom, there is an 'Advisory Messages' section displaying the message 'INST CMD BUILD Connected to command manager.'

Figure 3.34-1. Example 1: SSOR key command structure for SSOR KEY 11

Command Words  
0004 0FFF 0308

Nomenclature  
SSOR KEY 4095

To calculate parity byte (Key 4095), Exclusive Or ( $\oplus$ ) all bytes with FFh: 00h  $\oplus$  04h  $\oplus$  0Fh  $\oplus$  FFh  $\oplus$  03h  $\oplus$  FFh = 08h

Preamble	Byte Count	SSOR key #	Routing Code	Parity Byte
0000 0000	0000 0100	0000 1111 1111 1111	0000 0011	0000 1000
00h	04h	0FFFh	03h	08h

GMT: 074:09:16:06      Orbiter Gen Payload Build v1.2      F/V: 102/103

File CMD Type Operation      Help

Gen Payload 13302    Title: SSOR KEY 4095    GMT GEN:    EDITED

Orbiter OP Code	Two Stage	Dest Dep ID	PSP
03 0004	13	22	31
04 0FFF	14	23	32
05 0308	15	24	33
06	16	25	34
07	17	26	35
08	18	27	36
09	19	28	37
10	20	29	38
11	21	30	39
12			

Advisory Messages

INST CMD BUILD Connected to command manager.

Figure 3.34-1. Example 2: SSOR key command structure for SSOR KEY 4095



The following table contains the HEX command words needed for the first 100 SSOR key commands.

**Table 3.34-1. SSOR key command words**

Key Number	HEX Command Words		
0 (test)	0004	0000	03F8
1	0004	0001	03F9
2	0004	0002	03FA
3	0004	0003	03FB
4	0004	0004	03FC
5	0004	0005	03FD
6	0004	0006	03FE
7	0004	0007	03FF
8	0004	0008	03F0
9	0004	0009	03F1
10	0004	000A	03F2
11 (test/default)	0004	000B	03F3
12	0004	000C	03F4
13	0004	000D	03F5
14	0004	000E	03F6
15	0004	000F	03F7
16	0004	0010	03E8
17	0004	0011	03E9
18	0004	0012	03EA
19	0004	0013	03EB
20	0004	0014	03EC
21	0004	0015	03ED
22	0004	0016	03EE
23	0004	0017	03EF
24	0004	0018	03E0
25	0004	0019	03E1
26	0004	001A	03E2
27	0004	001B	03E3
28	0004	001C	03E4
29	0004	001D	03E5
30	0004	001E	03E6
31	0004	001F	03E7
32	0004	0020	03D8
33	0004	0021	03D9
34	0004	0022	03DA
35	0004	0023	03DB
36	0004	0024	03DC
37	0004	0025	03DD
38	0004	0026	03DE
39	0004	0027	03DF
40	0004	0028	03D0
41	0004	0029	03D1
42	0004	002A	03D2
43	0004	002B	03D3
44	0004	002C	03D4
45	0004	002D	03D5
46	0004	002E	03D6
47	0004	002F	03D7
48	0004	0030	03C8
49	0004	0031	03C9

Key Number	HEX Command Words		
50	0004	0032	03CA
51	0004	0033	03CB
52	0004	0034	03CC
53	0004	0035	03CD
54	0004	0036	03CE
55	0004	0037	03CF
56	0004	0038	03C0
57	0004	0039	03C1
58	0004	003A	03C2
59	0004	003B	03C3
60	0004	003C	03C4
61	0004	003D	03C5
62	0004	003E	03C6
63	0004	003F	03C7
64	0004	0040	03B8
65	0004	0041	03B9
66	0004	0042	03BA
67	0004	0043	03BB
68	0004	0044	03BC
69	0004	0045	03BD
70	0004	0046	03BE
71	0004	0047	03BF
72	0004	0048	03B0
73	0004	0049	03B1
74	0004	004A	03B2
75	0004	004B	03B3
76	0004	004C	03B4
77	0004	004D	03B5
78	0004	004E	03B6
79	0004	004F	03B7
80	0004	0050	03A8
81	0004	0051	03A9
82	0004	0052	03AA
83	0004	0053	03AB
84	0004	0054	03AC
85	0004	0055	03AD
86	0004	0056	03AE
87	0004	0057	03AF
88	0004	0058	03A0
89	0004	0059	03A1
90	0004	005A	03A2
91	0004	005B	03A3
92	0004	005C	03A4
93	0004	005D	03A5
94	0004	005E	03A6
95	0004	005F	03A7
96	0004	0060	0398
97	0004	0061	0399
98	0004	0062	039A
99	0004	0063	039B

## TITLE

PAYLOAD SIGNAL PROCESSOR CONFIGURATION MESSAGE UPDATE TO THE SM GPC

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

## PURPOSE

To define a standard set of procedures for using and building Payload Signal Processor (PSP) configuration message updates and for transmitting the contents to the SM GPC.

## RESTRICTIONS & CONSTRAINTS

These procedures are only valid in all ops modes of the SM major function.

## GENERAL

The PSP is configured and controlled by five 16-bit word configuration messages, which are stored only in the SM applications software. Each of these messages relates to specific payload requirements and provides all the information necessary to configure the PSP to support that payload for command through the hardline or the Payload Interrogator (PI) interface and the telemetry data transfer from the PI to the Payload Data Interleaver (PDI).

On missions that do not use the PSP or when all five PSP configuration messages IDs are not required, five messages are still allocated in SM memory.

The SM software will be updated with the flight-specific PSP configuration messages before each flight. These prestored SM PSP configuration messages can be found in the Payload Management Level C Requirements, JSC-19478, Table 7.17.1. This table should be compared against the Integrated Mission Orbiter Command and Data Annex (Annex 4), JSC-22636-XX, Table 19, which also displays PSP configuration messages.

Note: Changes to the prestored SM PSP configuration messages may or may not be required. For whatever reason, if an update is required, this SCP describes how to build and uplink the load to the SM GPC.

Note: To actually load the PSP with the desired configuration message, simply initiating a command destined for the PSP will configure the PSP. The SM GPC always precedes each PSP-destined command with a configuration message.

Note: Prior to the payload customer initiating required mission commands, the INST will verify that the first used SM prestored configuration message is accurate by uplinking a PL throughput command destined for the PSP. Using SCP 3.38, INST builds the command with the data portion of the command, which consists of one 16-bit word of all zeros (i.e., this corresponds to uplink word 3 being 0000 in hex). This is called the PSP DUMMY command. INST CMD BUILD display has templates of this command already available to modify for use.

**PROCEDURE**

A. PSP configuration message build

The PSP configuration message uses INST CMD BUILD and will be built by Instrumentation or Comm Support. The INST CMD BUILD display should have some PSP configuration message load files built that can be used as a template for the new load you are building. See Figure 3.36-1.

SEQ	Initiator	Action	Comments
1	INST	Call up the INST CMD BUILD display from the INCO GCS DNAV menu and select the PSP CONFIG option from the Operations menu	See SCP 5.142 for details on the description of the INST CMD BUILD display
2	INST	Enter a valid DSM number (13201-13250) with a title (such as PSP CONFIG FOR SPAS). The title can be any character string up to 21 characters long	
3	INST	If the DSM selected is an existing command load in the server, select the Clear option from the File menu	
4	INST	Select or enter the data required to build the PSP configuration message	The numbers inclosed in the "( )" are the values used in the PM Level C, Annex 4
5	INST	Select the Submit option from the Operations menu	The green Edited light will disappear
6	INCO	Verify the command by looking at it from the INST CMD BUILD display on the PSP Config subdisplay	

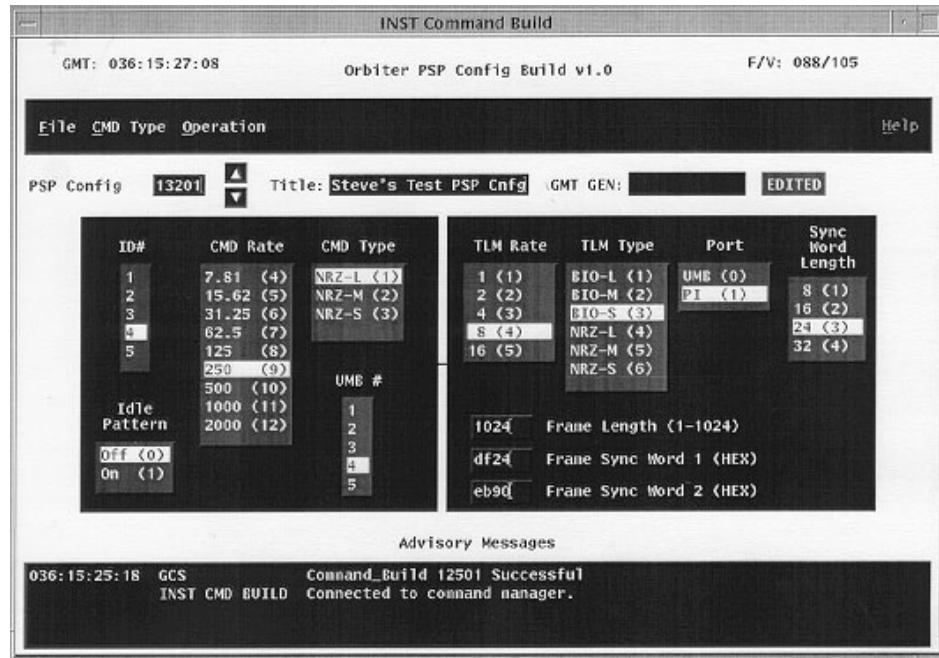


Figure 3.36-1. Example of the PSP BUILD display

B. PSP configuration message uplink to SM GPC

SEQ	Initiator	Action	Comment
1	INST	Select SM MF, AUTO EXECUTE, and LOAD mode	This U/L is a two-stage OP code
2	INST	On DSM, enter load number	
3	INST	Depress CMD INIT button	This load is being sent only to the SM computer, not the PSP!

**Table 3.36-1. P/L command rate**

Hexadecimal	Binary bit pattern		Command rate
	MSB	LSB	
0	0000		Not used
1	0001		Not used
2	0010		Not used
3	0011		Not used
4	0100		125/16 bps (7.81)
5	0101		125/8 bps (15.62)
6	0110		125/4 bps (31.25)
7	0111		125/2 bps (62.5)
8	1000		125 bps
9	1001		250 bps
A	1010		500 bps
B	1011		1000 bps
C	1100		2000 bps
D	1101		Not used
E	1110		Not used
F	1111		Not used

**Table 3.36-2. P/L command data type (PCM format)**

Hexadecimal	Binary bit pattern		CMD format
	MSB	LSB	
0	0	0	Not used
1	0	1	NRZ-L
2	1	0	NRZ-M
3	1	1	NRZ-S

**Table 3.36-3. P/L umbilical**

Hexadecimal	Binary bit pattern			Umbilical selection
	MSB	LSB		
0	0	0	0	Not used
1	0	0	1	Umbilical 1
2	0	1	0	Umbilical 2
3	0	1	1	Umbilical 3
4	1	0	0	Umbilical 4
5	1	0	1	Umbilical 5
6	1	1	0	Not used 6
7	1	1	1	Not used 7

**Table 3.36-4. Command subcarrier (idle pattern)**

Hexadecimal	Binary bit pattern		Idle pattern
0	0	0	OFF
1	0	1	ON

**Table 3.36-5. Telemetry data rate**

Hexadecimal	Bit pattern			Telemetry rate
	MSB	LSB		
0	0	0	0	Not used
1	0	0	1	1 kbps
2	0	1	0	2 kbps
3	0	1	1	4 kbps
4	1	0	0	8 kbps
5	1	0	1	16 kbps
6	1	1	0	Not used
7	1	1	1	Not used

**Table 3.36-1. Telemetry data type (PCM format)**

Hexadecimal	Binary bit pattern			PCM format
	MSB		LSB	
0	0	0	0	Not used
1	0	0	1	Bi $\phi$ -L
2	0	1	0	Bi $\phi$ -M
3	0	1	1	Bi $\phi$ -S
4	1	0	0	NRZ-L
5	1	0	1	NRZ-M
6	1	1	0	NRZ-S
7	1	1	1	Not used

**Table 3.36-2. Telemetry frame length**

Hexadecimal	Binary bit pattern		Frame length*
	MSB	LSB	
0	0	0000000000	Not used
1	0	0000000001	1
2	0	0000000010	2
•	•	•	•
•	•	•	•
•	•	•	•
3FF	0	1111111111	1023
400	1	0000000000	1024
401	1	0000000001	Not used
•	•	•	•
•	•	•	•
•	•	•	•
7FF	1	1111111111	Not used

\*Frame lengths specified are the number of 8-bit words (not including frame sync bits).

**Table 3.36-3. PSP port mode**

Hexadecimal	Binary bit pattern		Port
0	0	0	Umbilical
1	0	1	PI

**Table 3.36-4. Frame sync word length**

Hexadecimal	Bit pattern			Word length
	MSB		LSB	
0	0	0	0	Not used
1	0	0	1	8 bits
2	0	1	0	16 bits
3	0	1	1	24 bits
4	1	0	0	32 bits
5	1	0	1	Not used
6	1	1	0	Not used
7	1	1	1	Not used



**TITLE**

PAYLOAD SYSTEM COMMANDS VIA GCIL

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

The command restrictions/comstraints are shown in Figure 3.37-1.

COMMAND RESTRICTIONS/CONSTRAINTS    CMD CR#    Baseline    DATE: 11/12/87

1. Hazard/safety implication (should/are safed?): None
2. Valid software major modes (if applicable, include OPS Mode X01, X02...):

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC	X									
SM	X									
BFS	X									
PL	X									
OPS 0	X									

3. Valid OI loads:
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: None

**Figure 3.37-1. Command restrictions/constraints**

**PROCEDURES**

The Payload Interrogator (PI) and the Payload Signal Processor (PSP) interlock signals were not tied together to provide PI/PSP/ BOTH GCIL configuration redundancy between Payload Systems 1 and 2. When the S-bd PL Control switch is moved from the PNL to CMD position, the PI/PSP/BOTH GCIL configuration in the active (powered) system will be set to ON, while the PI/PSP/BOTH GCIL configuration in the inactive (unpowered) system will be set to OFF. Therefore, the inactive string is no longer configured like the active string. **This PL COMM System characteristic affects only switching strings.**

Operationally, this means the following:

If the S-bd PL CONTROL switch has been in the PNL, then CMD position, when swapping PL COMM systems via command, both a configuration command (PI/PSP/BOTH) and a system command (PL SYS 1/2 ON/OFF) must be sent. The order of the command does not matter, but both must be sent to power up the other PL COMM string LRUs. A configuration command is typically sent first. Once both have been sent, further switching between PI/PSP/BOTH on the same string requires only the configuration command, and switching between strings 1 and 2 requires only a system command. This cycle repeats for each PNL then CMD action on the A1L panel. (Therefore, the commands in *italics* in the following procedures may not be necessary.)

When the PI is powered OFF by the crew, the power for the channel select thumbwheels goes low. So, when the S-bd PL CONTROL switch is moved from PNL to CMD, the channel switches are read as 000. When the ground commands the PI ON, the PI will come up in channel 000. For the ground to avoid bringing up the PI in channel 000, first send a PI channel selection two-stage MRTC, then turn the PI on (PL INTGR - SEL 4804) or both the PSP/PIs on (PL PSP/INTGR - SEL 4805).

### PL COMM SYSTEM COMMANDING SCENARIOS

There are nine unique PL System commanding scenarios: PSP ON, PSP OFF, PI ON, PI OFF, PSP/PI ON, PSP/PI OFF, PI Channel Selection, Swapping Systems, and PL System Configuration for ERPCL.

Any command in *italics* may not be required as discussed in the first paragraph of this SCP.

For all cases, coordinate activities with PL DATA or PAYLOADS on INST COORD, inform INCO before any commanding, ensure that the PL Mode switch is in CMD, and verify end item response and configuration.

### PSP ON

1. If PI not required:

PL PSP - SEL 4803  
PL SYSTEM 1 (2) - ON 4800 (4802)

If PI required:

PL PSP/INTGR - SEL 4805  
*PL SYSTEM 1 (2) - ON 4800 (4802)*

2. INST uplinks PSP 1 (2) I/O reset 12547 (12548) to establish I/O with the SM GPC.
3. INST uplinks a PSP dummy command with the desired PSP configuration message ID to verify that the SM configuration message is accurate and the PSP does indeed get configured properly.

### PSP OFF

WARNING

Removing power from a PSP that has I/O established with the SM GPC will cause an S62 BCE BYP PSP 1(2) message.

1. If PI not required:

PL SYSTEM - OFF 4801

If PI required (PSP Bypass operations or Bent Pipe):

PL INTGR - SEL 4804

### PI ON

1. To avoid bringing up the PI in channel 000, a PI channel selection two-stage MRTC may be required. (See the PI CHANNEL SELECTIONS caution note.)
2. If PSP not required (PSP Bypass operations or Bent Pipe):

PL INTGR - SEL 4804  
*PL SYSTEM 1 (2) - ON 4800 (4802)*

If PSP required:

PL PSP/INTGR - SEL 4805  
*PL SYSTEM 1 (2) - ON 4800 (4802)*

- a. INST uplinks PSP 1 (2) I/O reset 12547 (12548) to establish I/O with the SM GPC.
  - b. INST uplinks a PSP dummy command with the desired PSP configuration message in order to verify that the SM configuration message is accurate and the PSP does indeed get configured properly.
3. The PI may require more configuration commanding for transmitter power levels, antenna polarization, modulation on/off, transmitter frequency sweep, or frequency sweep wide/narrow.

### PI OFF

WARNING

Removing a payload RF link may cause an S62 PDI DECOM FAIL message. Removing power from a PSP that has I/O established with the SM GPC will cause an S62 BCE BYP PSP 1 (2) message.

1. If PSP not required:

PL SYSTEM - OFF 4801

If PSP required:

PL PSP - SEL 4803

### PSP/PI ON

1. To avoid bringing up the PI in channel 000, a PI channel selection two-stage MRTC may be required. (See the PI CHANNEL SELECTIONS caution note.)
2. PL PSP/INTGR - SEL 4805.
3. *PL SYSTEM 1 (2) - ON 4800 (4802)*.
4. INST uplinks PSP 1 (2) I/O reset 12547 (12548) to establish I/O with the SM GPC.

5. INST uplinks a PSP dummy command with the desired PSP configuration message to verify that the SM configuration message is accurate and the PSP does indeed get configured properly.
6. The PI may require more configuration commanding for transmitter power levels, antenna polarization, modulation on/off, transmitter frequency sweep, or frequency sweep wide/narrow.

PSP/PI OFF

WARNING

Removing power from the PSP that has I/O established with the SM GPC will cause an S62 BCE BYP PSP 1(2) message; removing a payload rf telemetry link (PI or PSP off) may cause an S62 PDI DECOM FAIL message.

1. PL SYSTEM - OFF 480

PI CHANNEL SELECTION

<u>CAUTION</u>	
The PI transmitter may interfere with the orbiter S-band PM Transponder (XPNDR) receiver when the following channels/frequency settings are selected. Interference can be severe enough to capture the XPNDR receiver lock.	
<u>IF PI CHANNELS</u>	<u>AVOID XPNDR PM FREQ</u>
000-420, 900-909	LOW
421-882, 910-919	HIGH

Requirements:

1. All PI channel selection commands must be sent as two-stage MRTCs.
2. The first command in the MRTC MUST be PL FREQ SEL - RESET 4834. If this command is not issued first, erroneous PI channel selection will occur.
3. The subsequent MRTC PI channel selection commands should be in the sequence of 100's, TENS, then UNITS.

Example: To select PI channel 241:

An MRTC would be built as follows:

PL FREQ SEL - RESET	4834
PL FREQ 100 SEL - 2	4831
PL FREQ TENS SEL - 4	4828
PL FREQ UNIT SEL - 1	4822

SWAPPING SYSTEMS

1. Use two-stage MRTC for PI channel selection.

2. Select one of the following channels, depending on desired PSP/PI usage:  

PI INTGR - SEL	4804
PL PSP - SEL	4803
PL PSP/INTGR - SEL	4805
3. Then send one of the following messages:  

PL SYSTEM 1 - ON	4800
PL SYSTEM 2 - ON	4802
4. INST uplinks PSP 1 (2) I/O reset 12547 (12548) to establish I/O with the SM GPC.
5. If required, INST uplinks a PSP dummy command with the desired PSP configuration message in order to verify that the SM configuration message is accurate and the PSP does indeed get configured properly.
6. The PI may require more configuration commanding for transmitter power levels, antenna polarization, modulation on/off, transmitter frequency sweep, or frequency sweep wide/narrow.

### PL SYSTEM CONFIGURATION FOR ERPCL

The ERPCL cannot be directly controlled via ground command. However, the ground can enable/disable the ERPCL forward link by routing the command through the PSP output umbilical that is/is not connected to the ERPCL.

1. Disable ERPCL forward link:  

PL PSP CMD OUT - INT	4812
----------------------	------
2. Enable ERPCL forward link:  

PL PSP CMD OUT - UMB	4813
----------------------	------

(The proper configuration message is required to select the correct ERPCL command output umbilical.)

### ADDITION OPERATIONAL NOTES

1. Based on STS-57 (EURECA) and STS-51 (ORFEUS-SPAS) mission experiences and subsequent Electronic Systems Test Laboratory (ESTL) testing, 2250-MHz orbiter downlink FM transmission interfering with the payload return link is probable. Test results show that **ALL** PI received channels are susceptible to interference from the orbiter FM transmission (either TV or recorder source) when the upper hemiantenna is used. The lower hemi has a negligible effect on the operation of the payload return link. See SCP 3.96 for more details on PI frequency constraints. (This information came from an EV4/Systems Analysis and Test Branch memo, EV4-11/94-026 dated November 14, 1994.)
2. The potential exists to lose power to either the PI or PSP when the S-bd PL CONTROL switch is in the PNL position and the Power Select switch is moved. For example, if in PNL and both the PI and PSP are powered, taking the Select switch from BOTH to PSP can cause the PSP to lose power while the switch contact is moving from BOTH to PSP (break before make). Crew procedures should be written so that switch changes are performed, while in CMD, then the crew performs a switch to PNL, then back to CMD.

## TITLE

PAYLOAD DATA LOAD AND PAYLOAD THROUGHPUT LOAD GENERATION

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed pre-mission without review and approval at the FOIG.

## PURPOSE

To define a standard set of procedures for usage and generation of the Payload Data Load (PDL) and Payload Throughput Load (PTL).

## RESTRICTIONS & CONSTRAINTS

This procedure is only valid in all ops modes of the SM major function.

## GENERAL

The PDL and PTL types are of the same basic format; however, the OP code and onboard processing are slightly different. The basic format provides for destination selection, destination-dependent ID selection, and the number of valid words uplinked. These data are used by the SM application uplink software to determine which set of interface software should process the uplink load. The valid destinations follow:

- Payload Signal Processor (PSP)
- Standard Serial Interface (SSI)

The following destination-dependent IDs are

- For PSP - 0 to 5
- For SSI - 1 to 8

All others, except the ones identified previously, are invalid. In addition, the number of valid uplink 16-bit data words is different for each destination, and they are identified as follows.

- PSP - 0 to 64 words
- SSI - 1 to 32 words

As noted previously, PDL and the PTL are processed differently by the onboard uplink software. The PDL is a two-stage load and therefore requires a downlink of the Two-Stage Buffer (TSB) for verification and review prior to uplink of a two-stage buffer execute command. The PTL is loaded into the payload throughput buffer instead of the two-stage buffer, and, therefore, does not require a buffer execute command. The PTL command is transferred to its destination once the last command word has been received and no errors were detected.

## PROCEDURE

PDL and PTL command loads are built from the INST CMD BUILD display.

SEQ	Initiator	Action	Comments
1	INST	Call up the INST CMD BUILD display from the INCO GCS DNAV menu and select the Gen Payload option from the Command Types menu	See SCP 5.142 for more information on the INST CMD BUILD display
2	INST	Enter a valid DSM number (13301 to 13350 or 71201 to 71250; 712xx is used by the Payloads position only) with a title (such as PSP Dummy - 1). The title can be any character string up to 21 characters long	
3	INST	Select the options for  Oribter Op code: Two stage Single stage  Payload Dest: PSP SSI  Dest Dep ID: PSP = 1 - 5 SSI = 1 - 8	PDLs will use the two-stage buffer while PTLs are single stage and use the payload throughput buffer
4	INST	Fill in the hex character command words in the middle section of the display	If PSP is selected in step 3, command data words 3-66 are available, but if SSI is selected, only words 3-34 are available
5	INST	From the Operations menu, select the Submit option	The green Edited light will disappear as the command is sent to the command server

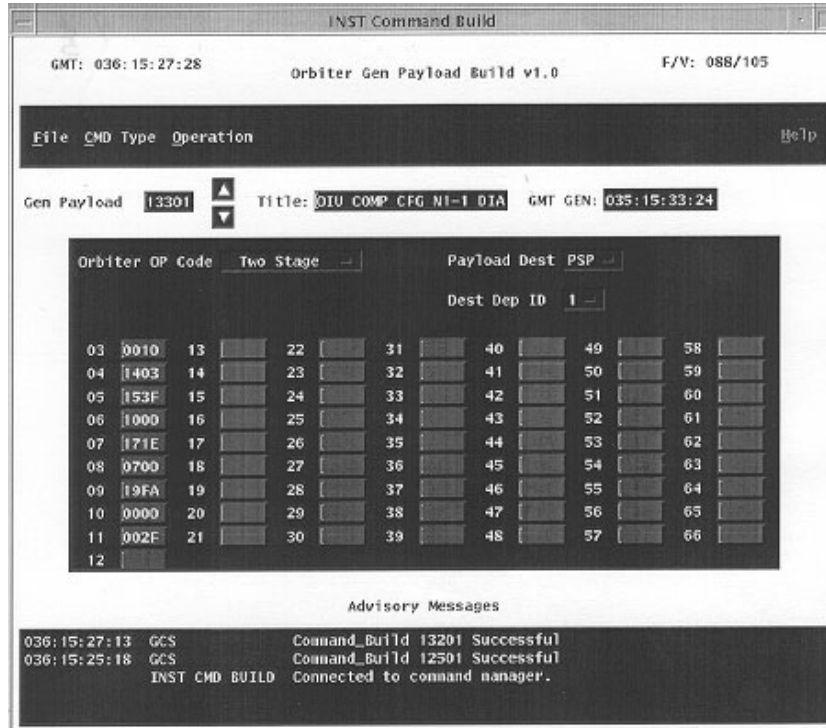


Figure3.38-1. Example of General Payload Load Build display



**TITLE**

CCTV CAMERA POWER STATUS WITHOUT TV DOWNLINK

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

This procedure allows INCO to determine which cameras are powered without TV downlink.

Figure 3.43-1 shows the command procedure restrictions for CCTV camera power status without TV downlink.

COMMAND RESTRICTIONS/CONSTRAINTS      CMD CR# Baseline      DATE: 11/12/87

1. Hazard/safety implication (should/are safed?): None
2. Valid software major modes (if applicable, include OPS Mode X01, X02....):

Major mode/ OPS	ALL	1	2	3	4	5	6	7	8	9
GNC	X									
SM	X									
BFS	X									
PL	X									
OPS 0	X									

3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: Ground CMD of CCTV cameras requires crew coordination.

**Figure 3.43-1. Command restrictions/constraints for CCTV camera power status without TV downlink**

## PROCEDURE

Be sure CCTV is in "Sync" mode. Sync mode may not be compatible with crew activities. Note that the VCU defaults to sync mode at power up.

- A. U/L DSM 4251 TEST PATTERN SEL
- B. U/L DSM 4249 DOWNLINK  
✓ ALC - "blank"
- C. U/L DSM 42XX CAMERA SELECT
- D. U/L DSM 4249 DOWNLINK

If ALC not = "blank" then camera is ON.

If ALC = "blank" then camera is OFF or malfunctioned.

REPEAT steps A through D for all cameras.

**TITLE**

CCTV CAMERA POSITIONING

**CAUTION**

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**PURPOSE**

This procedure allows the INCO to position the payload bay (PLB) cameras without TV downlink. This procedure should be used to preposition the cameras for an INCO-commanded PLB camera sequence. If the crew is using the TV, this procedure should not be used.

Note: Flight-specific rules should be checked for restrictions on PLB cameras before using this procedure.

Figure 3.44-1 shows the command procedure restrictions for this SCP.

COMMAND RESTRICTIONS/CONSTRAINTS      CMD CR# Baseline      DATE: 11/12/87

1. Hazard/safety implication (should/are safed?): None
2. Valid software major modes (if applicable, include OPS Mode X01, X02....):

Major mode/	ALL	1	2	3	4	5	6	7	8	9
OPS	X									
GNC	X									
SM	X									
BFS	X									
PL										
OPS 0	X									

3. Valid OI loads: All
4. Vehicle, LRU/hardware version constraints: None
5. Time constraints, crew coordination requirements: Ground CMD of CCTV cameras requires crew coordination.

**Figure 3.44-1. Command restrictions/constraints for CCTV camera positioning**

**PROCEDURE**

- A. U/L DSM 4200 VCU MAIN A
- B. U/L DSM 42XX CAMERA SELECT
- C. U/L DSM 4254 ZOOM OUT
- D. U/L DSM 4271 TILT DOWN
- E. U/L DSM 4273 PAN LEFT (A or C) (FWD or AFT)  
or  
4274 PAN RIGHT (B or D) (KEEL or SRMS)
- F. U/L DSM 4265 ZOOM STOP  
  
WAIT 30 SEC
- G. U/L DSM 4272 TILT STOP
- H. U/L DSM 4275 PAN STOP
- I. U/L DSM 4270 TILT UP  
  
WAIT 6 SEC
- J. U/L DSM 4272 TILT STOP
- K. U/L DSM 4274 PAN RIGHT (A or C) (FWD or AFT)  
or  
4276 PAN LEFT (B or D) (KEEL or SRMS)  
  
WAIT 14 SEC
- L. U/L DSM 4275 PAN STOP
- M. U/L DSM 4273 PAN/TILT RESET  
  
CONTINUE WITH NEXT CAMERA

## TITLE

PCMMU NOTES, PCMMU PGM MODE SELECTION AND AUTO LDR TFL LOAD

## GENERAL

- A. A problem exists with the PCMMU: If the program (PGM) mode of operation is selected by either Spec 62 or the onboard mode switch (S8, PNL C3), and the data random access memory (RAM) has not been loaded with a valid TFL format beforehand, the PCMMU will output a nonintelligent stream of data.

It was previously thought that if a nonintelligent stream of data occurred, the only action necessary was to select the FIXED mode by either the switch or Spec 62. Engineering and Development (E&D) has stated that on some occasions (specifically during STS-3 checkout), the PCMMU would not select the FIXED mode. E&D has further stated that this condition is due to the CMOS logic employed (the logic will not detect a mode change).

The solution to this condition is

1. Select the GPC mode (if in S2 or S9) or the FIXED mode on the mode switch.
  2. Either switch PCMMU's or power the PCMMU OFF, then ON. This action will put the PCMMU into the FIXED mode.
  3. Load the appropriate TFL (if in S2 or S9) via the cue card.
- B. The BFS GPC acquires the PCMMU 1&2 power switch discretes, V75S2107E and V75S2109E "PCM MASTER PWR ON," respectively, via MDM OF1. In the event that MDM OF1 shows failed (WRAP) and PCMMU's are switched to try to recover the MDM, there is a possibility that the BFS GPC will not proceed with the LDR TFL load.

The BFS GPC takes the PCMMU 1&2 power switch discretes, labels them PCMSWPST (PCMMU SWITCH PAST), and then stores them in RAM. On the next pass, the BFS takes the power switch discretes and labels them PCMSWCUR (PCMMU SWITCH CURRENT). The BFS then compares PCMSWCUR with PCMSWPST. If the two compare, the BFS will continue to update PCMSWCUR every pass and compare it with PCMSWPST. In the event that PCMSWCUR and PCMSWPST do not compare, the BFS will test to see whether the PCMMU power switch is off (explained in more detail below). If the PCMMU power switch is off, the BFS continues with the compare routine; if the switch is on, the BFS performs the LDR TFL load.

As an example, if PCMMU 2 is on and 1 is off, a value of 0,1 will be stored as PCMSWPST. Before the next pass, PCMMU's are switched so that PCMSWCUR will be 1,0. When the BFS compares PCMSWCUR with PCMSWPST, it will see a miscompare and test to see whether PCMSWCUR is a 0,0 (switch off). Since PCMMU 1 is powered, PCMSWCUR does not equal 0,0, and the BFS will perform the TFL load.

If the situation involves a PCMMU switch while MDM OF1 is failed, the BFS will use the random value in the active PCMMU's RAM as PCMSWCUR. Using the above example again, if PCMMU 2 is on and 1 is off, PCMSWPST will be 0,1. In this case, MDM OF1 fails and PCMMU are switched to try to recover OF1. Since OF1 is failed, PCMMU 1 will not receive the PCMMU 1&2 power switch discretes, and the BFS GPC will use the random value in PCMMU 1 RAM. If PCMMU 1 RAM comes up with a value of either a 0,1 (no change) or 0,0 (PCM off), the BFS will not perform the TFL load. If the RAM comes up with a value of 1,0 or 1,1 (a change and PCM on), the BFS will perform the TFL load.

Therefore, if MDM OF1 fails and PCMMU's are switched, there is a 50 percent chance that the auto TFL load will be performed. If the auto load is not performed after the first switch, cycling the PCMMU's several times will eventually cause the TFL auto load. Some discretion should be taken before cycling the PCMMU's several times because this action will cause total loss of data for short periods of time.

In the SMS when an MDM fails and PCMMU's are switched, the active PCMMU's RAM addresses for the failed MDM always come up with zeros. Therefore, in a sim, if MDM OF1 fails, there is no chance that the auto LDR TFL load will be performed.

**TITLE**

INTERPRETING PCMMU ELEMENT BYPASS INDICATIONS

**PURPOSE**

This procedure allows INST to analyze PCMMU element bypass indications to determine the affected OI MDM card/channel and MSID's.

**GENERAL**

The comm\_bypass display located under the INCO DNAV will indicate different types of PCMMU element bypasses. Six of these element bypasses occur on timer-initiated transactions between the SM GPC and the PCMMU (PMU TIO BYPASS). The other six indications are for bypasses for supervisor-call-initiated transactions between the SM GPC and the PCMMU (PMU SVC BYPASS). These bypass indications can be used to determine MDM, card/channel, and MSID's affected.

Each of these bypass indications represents a single downlisted parameter. This downlisted indication is actually the result of OR-combining up to 48 separate bypass indications for individual read elements. These bypass bits for the individual read elements are not downlisted in order to save downlist bandwidth. They are maintained in SM GPC memory and can be retrieved by downlist dumping of memory locations. In order to determine which MDM and which MSID's have been affected by a PCMMU element bypass, the bypass indications must be analyzed by the following procedure.

**PROCEDURE**

- A. Whenever a PMU bypass is on, it is first important to analyze the BITE words associated with the PCMMU and the OI MDM's. If an MDM or PCMMU BITE bit is on, this technique will allow fault identification to the lowest level in the MDM.
- B. If more than one bypass indication is on, it will be necessary to dump the GPC memory locations that contain the actual read element bypasses. This dump can be done by asking DPS to dump the following memory data:

<u>HAL name</u>	<u>HAL module</u>	<u>Size</u>
CSAS_ERT_DL	APPL.SRC.CSAERT	36 halfwords

The memory location for CSAS\_ERT\_DL is found in the HALSTAT global symbol dictionary, then in the DASS SM2/SM4 listing by memory address location. The contents of each address bit can be found in the master source listing under the application software module. The application software is written in HAL code, hence the name HALSTAT for HAL statistics.

CSAS\_ERT\_DL is a two-dimensional array (12 entries of 48 bits each or 3 halfwords). The bypass definition for each bit in this array is contained in HAL module APPL.SRC.CSAERT. This module identifies bypass indications by a V95 MSID number. The 48 bits in each entry correspond one-to-one with the 48 MSID of the form V95XnnnnX, where nnnn is defined in figure 3.53-1. Each bit that is on represents an element that is bypassed. The bypassed element can be mapped to the associated PMU address and OI MDM using the bypass bit map in the PMU ELEMENT BYPASS READ table. See table 3.53-1 for example. This number can be used to identify PCMMU RAM addresses that were being accessed by the GPC at the time of the bypass. To do this, look up the V95 MSID in the PMU ELEMENT BYPASS list located in the flight-specific INST binder at the INST console. Having located the bypass in the list, proceed to step F of this procedure.

PMU TIMER READ BYPASS BITS SM2		BYPASS WD/CYCLE 1			
MSID	ELEM NO	ADDR	LEN	MDM	RATE
V95X1261X	1	2328	31	OA02	.5 Cycle 1
V95X1262X	2	542	6	OA01	.5
V95X1263X	3	180	6	OA02	.5
V95X1264X	4	1192	2	OF04	.5
V95X1265X	5	1162	2	OF04	.5
V95X1266X	6	2812	15	OF04	1 Cycle 7
V95X1267X	7	2548	10	OF01	1
V95X1268X	8	3467	9	SSC	1
V95X1269X	9	2224	6	SSC	1
V95X1270X	10	2605	6	OF01	1
V95X1271X	11	2476	4	OA01	1
V95X1272X	12	928	4	OF02	1
V95X1273X	13	1027	3	OF03	1
V95X1274X	14	3431	3	SSC	1
V95X1275X	15	826	2	OF02	1
V95X1276X	16	1174	2	OF04	1
V95X1277X	17	2427	2	OA03	1
V95X1278X	18	3855	2	EXC	1
V95X1279X	19	136	1	OA02	1
V95X1280X	20	3017	1	SSC	1
V95X1281X	21	2708	1	OF03	1
V95X1282X	22	1119	1	OF04	1
V95X1283X	23	3364	1	SSC	1
V95X1284X	24	1431	1	PDI	1 End of Cycle 1
V95X1285X	25	2554	28	OF01	.5
V95X1286X	26	2365	6	OA02	.5
V95X1287X	27	2652	6	OF02	.5
V95X1288X	28	2362	2	OA02	.5
V95X1289X	29	1151	2	OF04	.5 End of Cycle 7
V95X1290X	30				
V95X1291X	31				
V95X1292X	32				
V95X1293X	33				
V95X1294X	34				
V95X1295X	35				
↓	↓				
↓	↓				
↓	↓				
V95X1308X	48				

**Figure 3.53-1. PCMMU timer read bypass table**

- C. If only one bypass is on, consult the inst\_mgmt display. Observe the err cnt (V92U0600C) in the PCMMU column. This is the number of PCMMU I/O errors observed by the GPC since the last PCMMU I/O error reset. If this number is more than two, then more than one PCMMU read element bypass has occurred. If this is the case, dump the GPC locations per step B, and after locating the bypass bits in the list, proceed to step F of this procedure.
- D. If only one bypass is on (the err cnt is 2), then the number of the read element that was bypassed is available in telemetry. Consult the inst\_mgmt display. Copy down the PCMMU ELEMENT BYPASS NUMBER (V92U0599C) displayed in the PCMMU column.
- E. Go to the PMU ELEMENT BYPASS list located in the flight-specific INST binder at the INST console. Locate the page associated with the PMU element bypass light that was observed. For example, if the PMU TIO 1 BYPASS light was on, find the page labeled PMU TIMER READ



BYPASS BITS BYPASS WD/CYCLE 1. Using the PCMMU ELEMENT BYPASS NUMBER from the inst\_mgmt display, locate the line with the same number. For example, if the PCMMU ELEMENT BYPASS NUMBER read 6, locate the line labeled ELEMENT NO. 6.

- F. Write down the RAM address and the number of words for the bypass that has been identified. Note that on this same line it lists the MDM (or PDI) that has been affected by this bypass.
- G. The mapping of PCMMU RAM address to MSID can be found in the SM Level C FSSR table 7.1, or by using the mission information system (MIS) query application. If using the SM Level C FSSR, then if the number of words indicated for the transaction is one, simply locate the RAM address in the list. On the same line in the list, the MSID associated with the RAM address will be identified. If the number of words in the transaction is greater than one, locate all RAM addresses between the starting address indicated in the PMU bypass list and the sum of the starting address and the number of words. Be aware that some of the RAM addresses point to parent words that may contain measurements from many subsystems. Using MIS and the list of MSID affected by the bypass, INST can identify the cards and channels of the OI MDM's that have been bypassed. This capability enables INST to identify a single card or channel failure to the lowest possible level.
- H. A more straightforward alternative is to use MIS from the onset. The mapping is quite easy this way since once the program is provided with the address(s) to map, it provides not only the MSID but also the MDM, card, and channel, if correctly specified in the "Create Your Own Format" option for SCAP.
- I. Notify the appropriate subsystems that their parameters are no longer available to the SM GPC. This step may be of major importance because several critical functions (antenna management, payload bay door operations, etc.) use data acquired in this manner.

NOTE

The identification of card or channel failure by this technique does not necessarily mean that the MDM has failed. The only definitive information gained in this technique is that the SM GPC can no longer acquire data gathered by the PCMMU from a certain card/channel in an OI MDM. The failure could be in the GPC or MDM.

**Table 3.53-1. Layout of CSAS ERT DL**

Entries	Addresses
← 48 bits long ⇒	
Cycle 1/7 timer I/O	(1261 - 1308)
Cycle 1/7 SVC I/O	(2501 - 2548)
Cycle 2/8 timer I/O	(1310 - 1357)
Cycle 2/8 SVC I/O	(2550 - 2597)
Cycle 3/9 timer I/O	(1361 - 1408)
Cycle 3/9 SVC I/O	(2601 - 2648)
Cycle 4/10 timer I/O	(1410 - 1457)
Cycle 4/10 SVC I/O	(2650 - 2697)
Cycle 5/11 timer I/O	(1461 - 1508)
Cycle 5/11 SVC I/O	(2701 - 2748)
Cycle 6/12 timer I/O	(1510 - 1557)
Cycle 6/12 timer I/O	(2750 - 2797)

**TITLE**

SM GPC REASSIGNMENT ACTIONS/CLEANUP

**PURPOSE**

To describe INCO actions when the SM GPC is going to be reassigned. The SM GPC is critical for many INCO activities and when it is unavailable, INCO must be aware of the many actions that may be required to maintain communications with the orbiter. The actions and cleanup steps should be reviewed and completed ASAP after INCO is informed that the SM GPC will be reassigned or has failed.

The INCO team should verify each step as completed or not applicable.

**ACTIONS SUMMARIZED (PRIOR TO SM DOWN AND DURING NO SM OPS)**

- A. Are there any Ku radiation constraints? If so, command Ku to STBY.
- B. Is the NSP configured for Ku fwd? If so a panel command may be required to regain comm.
- C. Verify SPC and TEC buffer contents and impacts if the stored commands are not executed.
- D. Verify if configured for EARLY/MIDPASS handover.
- E. Verify which antenna is required manually per upcoming maneuver, H/O or ZOE.
- F. Verify that the TDRS vector configuration will maintain comm.
- G. Disable Payload commanding.

**CLEANUP ACTIONS SUMMARIZED (NEW SM UP AND OPERATIONAL)**

- A. Verify that GPC is selecting correct antenna for active event.
- B. Antenna selection back to GPC (as required).
- C. Uplink TDRS vectors (as required).
- D. GCIL decoders commanded ON.
- E. Ops recorder reconfig.
- F. Reload PDI and Low data rate TFL (if crew did not).
- G. Configure Ku-band BETA and RF Protect Boxs per timeline requirements, then turn ON Ku-band system.
- H. PSP item 6 or 7 via crew or INCO uplink.
- I. Clean up the Onboard Command Buffers display as required.
- J. Re-enable Payload commanding.
- K. Check for any TMBU uplinked after the last SM checkpoint (may have to re-uplink).

## TITLE

LOSS-OF-VOICE PROCEDURE

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or be changed premission without review and approval at the FOIG.

## PURPOSE

To define procedures to be used in the event of loss of two-way voice communications with the ground.

## RESTRICTIONS & CONSTRAINTS

This procedure is only valid in all ops modes of the GNC, SM and BFS major functions.

## GENERAL

According to the flight rules, loss of voice during the ascent phase requires the crew to perform next day primary landing site (PLS) deorbit if command is still available. If both voice and command are lost during ascent, the rules require an orbit 2 PLS deorbit. Once the "go for orbit" call has been given, loss of voice necessitates a next PLS entry if command is available. If unavailable an ELS landing may be required, depending upon state vector stability. Therefore, it is important to keep the crew informed of the uplink command status. Refer to Flight Rules A11.1.2-1 and A11.1.2-2, the COMM LOST procedure in the Ascent Pocket Checklist, and SSR 1 in the communications section of the Crew Malfunction Procedures.

## PROCEDURE

See the Flight Data File Ascent Pocket Checklist and COMM SSR-1.

Without voice, several commands can be used to inform the crew that uplink command is still available. The uplink activity indicator may be commanded on and off cyclically via GNC and/or SM (not BFS) to cause a flashing "UL" indication on the associated crew displays. Additionally, any time a load is retained in either the GNC, SM, or BFS two-stage buffers, the flashing "UL" will appear on the appropriate displays driven by that GPC major function. It is also possible to get the crew's attention by deliberately causing an alarm via either an NSP switch, a crew alert command that causes a class 3 alert (but no message), or the abort light. To minimize any uncertainty, it is a good idea to precoordinate with the crew the method to be used.

Once in orbit, the audio central control unit (ACCU) bypass connectors may be installed via IFM in an attempt to restore S-band or Ku-band (but not UHF) voice in the event of a dual ACCU failure. Should this attempt be unsuccessful, the steps defined in COMM SSR-1 of the Malfunction Procedures book may be consulted. These steps include: OCA telecon if available will restore 2 way voice comm, while Ku band is deployed.. All these methods (including SAREX if flown) bypass the orbiter audio system. The following are the appropriate DSM numbers:

UL activity on DSM 4064 (not BFS)

UL activity off DSM 4065 (not BFS)

For providing a flashing "UL" on a BFS display, select "MANUAL EXEC" on the command panel and uplink, but do not execute, a BFS two-stage load.



## TITLE

TO DETERMINE REDUNDANCY OF AUDIO CONFIGURATION CONTROL DATA

## GENERAL

The audio center panel has a control data interface to the audio center control unit (ACCU) through the pilot (PLT) and mission station (MS) audio terminal units (ATU). The serial data routed from each ATU is a 128-bit Manchester encoded word transmitted every 5.12 milliseconds. This data word includes both station control signals as well as system configuration control signals. The configuration signals are unique to the PLT and MS ATUs. They control switching and routing functions within the ACCU when interfacing with external systems, such as routing air-to-ground loops to the NSP that is currently active.

The serial data word contains a status bit that is transmitted to the ACCU acknowledging which NSP is presently active. By switching NSP's and subsequently their active states, proper operation of audio configuration control data via the PLT and MS ATUs can be determined.

## PROCEDURE

To check for operation of the mission station configuration control data

PNL 09 (PLT ATU)

- Right audio power SW - OFF

PNL R10 (MS ATU)

- S6 MS audio power SW - AUD/TONE or AUD

For the next steps, select an audio station that is known to be operating properly other than 09 (PLT) or R10 (MS)

PNL X (05 CDR, L9 PS, or A13 OS)

- A/A SW - OFF
- Verify that PNL is configured for normal operation and that A/G 1 SW (S2) is in T/R.
- Contact CAPCOM on A/G 1 and request that INCO switch to alternate NSP.
- Wait approximately 1 minute for CAPCOM to confirm NSP switch.
- After confirmation, conduct short voice check with CAPCOM on A/G 1.

If OK, then MS data word is OK. If CAPCOM does not reply, then configuration control data from MS ATU has probably failed.

PNL 09 (PLT ATU)

- Right audio power SW - AUD/TONE or AUD.

To check for operation of the right (PLT ATU) audio station configuration control data:

PNL R10 (MS ATU)

- MS audio, power SW - OFF.

PNL 05 (PLT ATU)

- Right audio power SW - AUD/TONE or AUD

For the next steps, select an audio station that is known to be operating properly other than 09 (PLT) or R10 (MS).

PNL X (05 CDR, L9 PS, or A13 OS)

- A/A SW - OFF
- Verify that PNL is configured for normal operation and that A/G 1 SW 1(S2) is in TR.
- Contact CAPCOM on A/G 1 and request that INCO switch to alternate NSP.
- Wait approximately 1 minute for CAPCOM to confirm NSP switch.
- After confirmation, conduct short voice check with CAPCOM on A/G 1.

If OK, then pilot data word is OK. If CAPCOM does not reply, then configuration control data from PLT ATU has probably failed.

PNL R10 (MS ATU)

- MS audio, power SW - AUDIO/TONE or AUD.

**TITLE**

EVA/UHF CONFIGURATION PLAN

**PURPOSE**

This procedure shows the different configurations for UHF communications during EVA operation.

One-man EVA

Ground	Orbiter	EVA crew	
Dual GSTDN site (comm config J)  259.7 MHz  CAPCOM uplink A/G 1 only	Mode - EVA  Freq - 296.8	Mode - B Tx 279.0	RX 259.7 296.8
UHF only site (comm config K)  259.7 MHz  Note: Ground cannot RCV EVA 1 or EVA 2	Mode - Simplex  Freq - 259.7	Mode - BU Tx 259.7	RX 259.7 296.8  Note: Crewmember must be at least 10 feet from belly antenna

Two-man EVA

Ground	Orbiter	EVA crew	
Dual GSTDN site (comm config J)  259.7 MHz  CAPCOM uplink A/G 1 only	Mode - EVA  Freq - 296.8	Mode - A Tx 259.7	RX 279.0 296.8  Mode - B RX 259.7  TX 279.0 296.8
UHF only site (comm config K)  Note: Ground cannot RCV EVA 1 or EVA 2	Mode - Simplex  Freq - 259.7	Both crewmembers switch to BU RX 259.7  Note: Comm between all parties must be simplex	

Note: For TDRS operations, the configuration is November. Stations under TDRS with UHF are scheduled as backup to receive 259.7 and 279.0. If contingency, site will uplink on 259.7 (configuration kilo).

While in the EVA mode, the orbiter receives three frequencies: 259.7 constant key biomed from EVA 1, 279.0 constant key biomed from EVA 2, and the 296.8, which is the only open receiver for comm as long as the in-vehicle crewman is not talking. Should the ground need to talk to the crew via UHF, several calls should be made on 296.8 to inform the crew to go to UHF-only configuration (EVA Checklist) where EVAs 1 and 2 go to backup, and the orbiter goes simplex with 259.7 frequency selected. All parties will



communicate in a simplex mode, and at LOS of YAR will reconfigure to EVA comm configuration (EVA Checklist). The ground normally monitors both 259.7 and 296.8. Should the crew call, the ground will be on 259.7 to talk to the crew.

#### **How to configure for a PMC during an EVA.**

The goal of this configuration is to provide a secure A/G loop for a PMC and still maintain communications for the EVA.

The normal action that the crew takes to configure for a PMC is to verify that the UHF is OFF. This action will need to be omitted because the EVA communication is through the UHF system. Since A/G 1 is the prime loop for EVA communications, the PMC should be conducted on A/G 2. Although an FCOH procedure states that A/G 1 is the prime channel for PMC communications, A/G 2 may be used, if required.

The crew will need to select an ATU and configure it for the PMC by placing its A/G 2 switch in T/R. The A/G 1 and A/A switches on the same ATU should be selected to RCV or OFF. The crew should also check on panel A1R that neither of the AUD CTR VOICE RCD selections for channels 1 and 2 is selected for A/G 2. Channel 2 should already be selected to A/G 1 for the EVA. The crew should also verify on the same panel that the AUD CTR UHF A/G 2 switch is OFF. This will provide voice recording of the EVA on A/G 1 and secure the PMC on A/G 2 from being recorded onboard the orbiter. GC can then have A/G 2 secured to the SURGEON's keyset for the PMC.

This configuration assumes that the PMC is for someone other than an EVA crewmember. There is no way to secure the RF UHF link to the EVA crewmembers. A PMC could be conducted with an EVA crewmember only if he or she is hardline in the airlock.

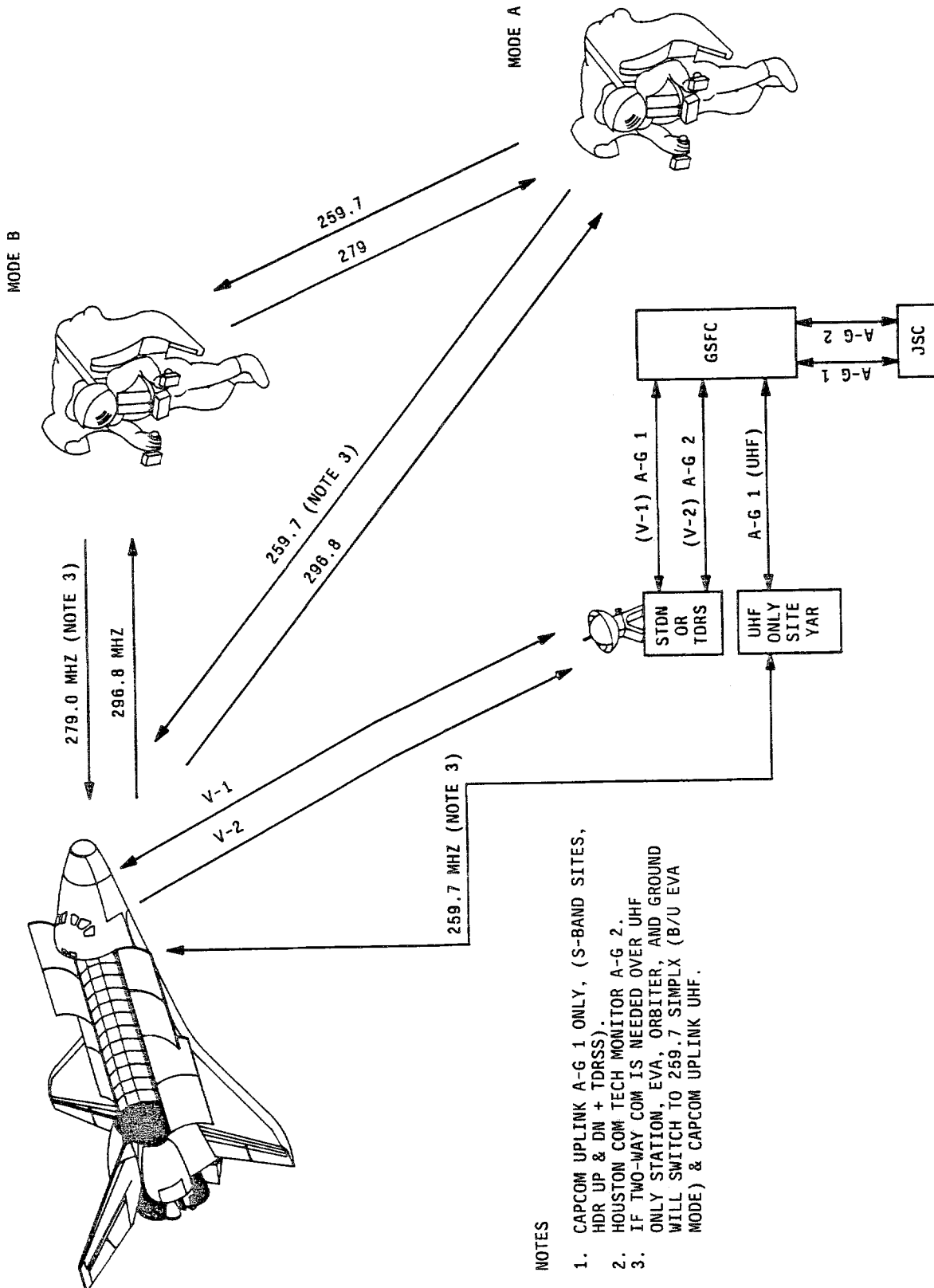


Figure 3.63-1. EVA GSTDN communications

**TITLE**

UHF LINK RECOVERY

**PURPOSE**

The purpose of this procedure is to recover the UHF link in a case where there is loss of downlink modulation on the UHF carrier but carrier can still be keyed.

Possible causes:

- A. Loss of the primary A/A bus output amplifier in the ACCU.
- B. Loss of the A/A enable (bit 18) signal from the A/A T/R switch on panel A1. (Bad switch connect.)
- C. UHF transmitter fail.

**PROCEDURE**

Nominal configuration

<u>ATU STATION</u>	<u>AG 1</u>	<u>AG 2</u>	<u>A/A</u>
MS	OFF	T/R	OFF
AIRLOCK	OFF	OFF	OFF
CDR, PLT, PS,OS, MD CCU, MD SPKR	T/R	RCV	T/R
AUDIO CENTER (PNL A1)	OFF	OFF	T/R

RECOVERY

- A. Switch to secondary circuit (#2) in ACCU.
- B. Switch to alternate UHF frequency and reconfigure sites. If UHF still not recovered, place A/G 1 switch on panel A1 to T/R.

If UHF recovered, then for S-band only sites - no problem. For a dual site with simultaneous uplink, the UHF uplink will be turned around on the S-band A/G 1 downlink. The S-band A/G 1 uplink will be present at the input to the UHF transmitter, but it will not get on the UHF downlink unless the crew keys the transmitter.

For a dual site, to minimize the possibility of uplink turnaround, CAPCOM should select A/G 1 uplink only. The only turnaround path would be A/G 1 uplink through the UHF, but for this to occur, the crew would have to key the transmitter.

Alternately, place A/G 2 switch to T/R on panel A1 and on audio panels (ATUs) being used by the crew. For S-band or UHF-only sites - no problem. For a dual site with simultaneous uplink, the UHF uplink will be turned around and downlinked on A/G 2.

This configuration would necessitate onboard changes for A/G 2 operations (TIPS, PADAM, etc.)

Since the intent of reconfiguration is to recover UHF with minimum impact to normal operations, tying the A/G 1 bus to the UHF transceiver and having the CAPCOM uplink on A/G 1 only at a dual site is highly recommended.

**TITLE**

ACCU BYPASS

**PROCEDURE**

A. Loss of two ACCU's

Perform the full IFM "ACCU BYPASS CONNECTOR INSTALLATION" (p. A1). This procedure will put the PLT audio terminal unit (ATU) hot mike to AG 1 of NSP 2 and the CDR ATU hot mike to AG 1 of NSP 1. Crew will configure as follows:

For NSP 2;

05 LEFT AUDIO CONTROL - RIGHT  
09 RIGHT AUDIO CONTROL - NORM

If NSP 1 is selected

05 LEFT AUDIO CONTROL - NORM  
09 RIGHT AUDIO CONTROL - LEFT

B. Loss of one ACCU [J4 ACCU BYPASS]

1. Perform the IFM "ACCU BYPASS CONNECTOR INSTALLATION" (p. A1), but do only the J4 positions (i.e., do not disconnect cables from ACCU J3) and power the good ACCU back up when the procedure is finished.

Use AG 1 with NSP 1 (AG 2 is lost).

Use AG 2 with NSP 2 (AG 1 is hot to PLT ATU).

09 R AUD CNTL - LEFT  
05 L AUD CNTL - NORM

A1 AUD CNTR VOICE RCD SEL CH 1 - ICOM A

CH 2 - ICOM A

The following functions have been lost:

PS ATU  
OS ATU  
AL ATU  
NSP 1 AG 2  
TACAN 3 TONES  
NSP 1 RCD V2  
NSP 2 RCD V 1  
C&W (B) VIA ACCU, MD SMU IN ACCU/BYPASS IS OK  
ICOM B - PLB (CCTV)  
ICOM B - T-O UMB

Only ICOM A is being recorded by the OPS recorders (on channel 2 if using NSP 2 or channel 1 if using NSP 1).

2. For a subsequent failure, reconfigure as follows.
  - a. ACCU failure (the remaining one)
 

If on orbit, complete the ACCU BYPASS procedure.

If during entry,   09 R AUD CNTL - NORM  
                          05 L AUD CNTL - RIGHT

This places both CDR and PLT hot mic to NSP 2 A/G 1. AG 2 on NSP 2 and both AG 1 and AG 2 on NSP 1 will be dead. No UHF as well.
  - b. NSP failure
 

INCO switch NSP's (or crew do PNL/CMD) and use alternate A/G. (AG 1 on NSP 1 and AG 2 on NSP 2). No loss of voice capability.
  - c. CDR ATU failure
 

If on orbit and time permits, remove J4 bypass. If during entry,

          09 R AUD CNTL - NORM  
          05 L AUD CNTL - RIGHT

Same impact as (a).

	ACCU FUNCTIONS	FUNCTIONS REMAINING AFTER BYPASS
	<u>J3</u>	<u>Full bypass (J3 and J4)</u>
BYPASS	CDR ATU (STA 1) MS ATU (STA 3) MD SMU (STA 6) MD CCU (STA 7) NSP 2 AG 2 NSP 1 AG 1 UHF TACAN 1 TONE TACAN 2 TONES NSP 1 RCD CH 1 NSP 2 RCD CH 2 C&W TONES - A ICOM A - PLB (CCTV) ICOM A - LAUNCH UMB IR AM AUDIO (NOT USED)	CDR ATU (STA 1) PLT ATU (STA 2) NSP1 AG1 NSP2 AG1
	<u>J4</u>	<u>J4 BYPASS</u>
	PLT ATU (STA 2) PS ATU (STA 4) OS ATU (STA 5) AL ATU (STA 8) NSP 1 AG 2	PLT ATU (STA2) NSP2 AG1 ALL J3 FUNCTIONS

ACCU FUNCTIONS

FUNCTIONS REMAINING  
AFTER BYPASS

NSP 2 AG 1  
TACAN 3 TONES  
NSP 1 RCD CH 2  
NSP 2 RCH CH 1  
C&W TONES - B  
ICOM B - PLB (CCTV)  
ICOM - B LAUNCH UMB  
IR FM AUDIO (NOT USED)  
EXP RCDR AUDIO (NOT USED)

For full implementation of the IFM procedure, the CDR is hot mike to A/G 1 of NSP 1 in addition to the PLT's ATU being hot mike to A/G1 of NSP 2. All other functions are lost. If only the J4 ACCU bypass is performed, the PLT is hot mike to A/G 1 of NSP 2. All other J4 functions are lost.

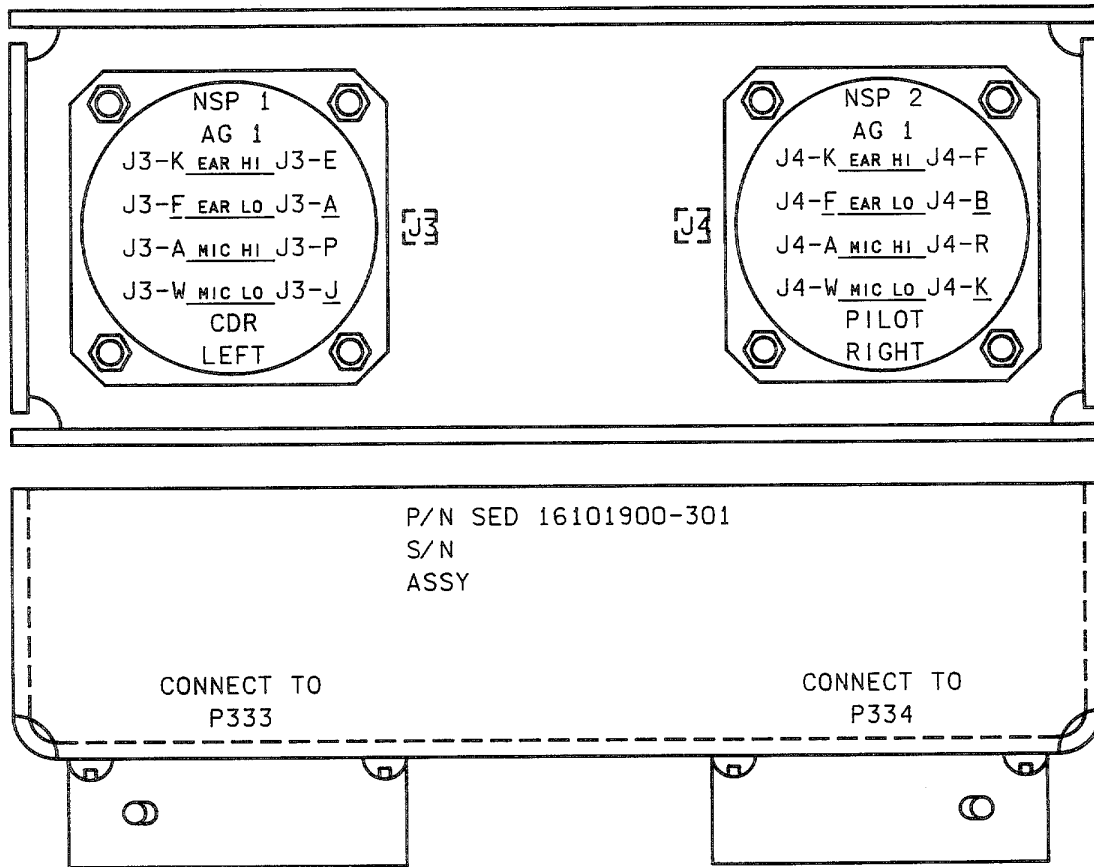


Figure 3.65-1. ACCU bypass connector module

## TITLE

S-BAND AND KU-BAND RADIATION MANAGEMENT DURING PAYLOAD AND EVA OPERATIONS

### CAUTION

This procedure is governed by FCOH procedure 3.1 and is not to be changed in real time without review and approval of the Flight Director or changed premission without review and approval at the FOIG.

## PURPOSE

This procedure defines steps taken by the lead INCO for a flight to develop a mission-specific communications plan that will avoid S-band or Ku-band radiation of either a payload or an EVA crewmember.

## PROCEDURES

### A. Ku-band $\beta$ mask DETERMINATION and radiation management planning

Several of the steps used for determining acceptable Ku-band system management planning are identical for both EVA crewmembers and payloads. Differences will be noted where required.

Radiation limits for payloads are defined on a mission-dependent basis. Radiation limits for EVA crewmembers are based on the specified limits of the EMU or 20 volts/meter (V/m). This represents the limit of testing on the EMU's. The human exposure limit is 137 V/m for a period not to exceed 6 minutes per ANSI C95.1-1982. This requires that for all EMU operations there be no allowed radiation of the EVA crewmember by the Ku-band main beam.

1. The following steps are provided as a general outline for determining the Ku-band system management.
  - a. EVA work area determination - Meet with EVA personnel and get from them the defined work areas for all mission-specific EVA's. Include in this a determination of the route that will be taken from airlock to worksite, worksite to worksite, and worksite to airlock. Also determine the work "volumes" that will be used by the crewmember once he is at the worksite.

These volumes should only include nominal activities planned for the EVA timeline. Incidents such as the loss of grip by the crewmember and subsequent retention by a tether, that occur external to a defined worksite volume cannot be predicted and do not need to be considered.
  - b. Payload location determination - Depending upon the payload, meet with either Payloads or RMS to determine the location and orientation of the payload during all flight phases. Often this step will not be required since the Pointers will already have certified models for use in the next step.
2. Contact the lead Pointer for this particular flight and request that plots showing the locations previously defined be created with several  $\beta$  masks superimposed upon them. Pointing has certified tools to provide this information.

3. Determine the necessary  $\beta$  values for protection of the EVA crewmember/payload and develop a management plan that includes this data. The  $\beta$  mask determination may require evaluation of payload constraints that require additional protection beyond the minimum  $\beta$  angle that prevents main beam impingement. An example of this would be the STS-48 UARS payload requirement for an additional 5° safety zone beyond this minimum  $\beta$ . Consider that the use of a  $\beta$  mask is not the only accepted means of protection as long as the radiation limits are not exceeded. For EVA, it is allowable to use non- $\beta$  means per Flight Rules. See SCP 3.77 for building RF protect boxes.
4. Document this plan through the use of mission-specific flight rules and the communications planning memo.

B. S-band Radiation Management Planning

S-band radiation from any of the three sources (PM, FM, or PI) has never been identified as a significant cause of concern for payloads. A concern relating to EVA operations has been identified because the specified EMU S-band radiation limit is 20 V/m. Just as with Ku-band, this value exists it is the upper limit of testing on the EMU's. Also, as with Ku-band, the radiation limit for S-band exposure in humans is 137 V/m for a period not to exceed 6 minutes per ANSI C95.1-1982.

1. S-band PM - The S-band PM antennae beams, since they provide the prime orbiter operational link, provide the most challenge for management. EMU avoidance of the PM antenna beams is the preferred method of management. The avoidance area is defined as that area within 1 meter of any S-Band antenna, per the EVA flight rules.

Other considerations

- a. Orbiter attitude control to force the selection of only those antennae  $\approx 180^\circ$  away from the EVA worksite
  - b. Inhibition of S-band pointing with commanding of antenna selections via RTC or, based on the ATL, via SPC
  - c. Crew control via the C3 switch is possible, but radiation of the crewmember is possible as the switch is cycled through different positions to the desired location.
  - d. Coordination with FAO/POINTING is required since other constraints must be considered, such as thermal and lighting concerns.
2. S-band FM - The S-band FM antennas do not pose as significant a threat as the PM antennas pose. If avoidance of the PM antennas is the chosen option, then no evaluation of the FM system is required because its avoidance area is contained in the PM avoidance area. The FM avoidance area is a cylinder with a radius of 2 feet centered on  $X_0 = 510$ ,  $Y_0 = 0$ ,  $Z_0 = 500$ , and extending 3 feet above the orbiter skin. A similar area would exist for the lower FM antenna; however since no EVA's are planned to this region at this time, it is not included in these considerations or Flight Rules. The EVA flight rule specifies a 1 meter keep-out zone for all S-Band antennas.

Other considerations

- a. The FM system can be turned off during the EVA.
- b. The lower hemi can be "forced" via crew control, or if SM antenna pointing is inhibited, can be controlled via ground command.



- c. EVA crewmember avoidance of the area may be taught as a part of training.
3. S-band payload interrogator (PI) - The PI, as with the FM, can be operated without restriction if a decision is made to avoid the PM antennas. The PI avoidance area is the cylindrical volume 2 feet in radius centered on  $X_0 = 558$ ,  $Y_0 = 0$ ,  $Z_0 = 500$ , and extending 3 feet above the orbiter skin, not including the area within the payload bay. The EVA flight rule specifies a 1 meter keep-out zone for all S-Band antennas.

Other considerations

- a. The PI can be turned off during the EVA.
- b. The PI transmitter power can be placed in low power. There are no restrictions for EVA/PI operations if this is done.
- c. EVA crewmember avoidance of the area may be taught as a part of training.