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Flight Procedures Handbook

STS-2

Post Insertion Deorbit Prep
Sections 1-6

Flight Operations Directorate
Operations Division

Final
August 31, 1981



National Aeronautics and
Space Administration

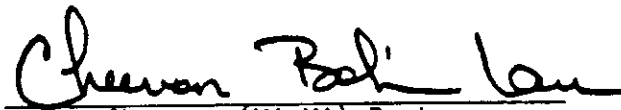
Lyndon B. Johnson Space Center
Houston, Texas

FLIGHT OPERATIONS DIRECTORATE
OPERATIONS DIVISION

STS-2 POST INSERTION DEORBIT PREP
SECTIONS 1-6
FLIGHT PROCEDURES HANDBOOK

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PREPARED BY

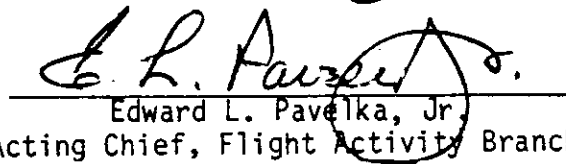


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FLIGHT PROCEDURES HANDBOOK PUBLICATIONS

The following is a list of the Integrated Flight Procedures Handbooks of which this document is a part. These handbooks document integrated and/or flight procedural sequences covering major STS crew activity plan phases.

<u>Title</u>	<u>JSC No.</u>
ASCENT/ABORTS	10559
ENTRY	11542
RENDEZVOUS/ORBITAL NAVIGATION	10589
OMS/RCS	10588
ATTITUDE AND POINTING	10511
STS WORKDAY	10541
SPACELAB ACTIVATION	10545
SPACELAB DEACTIVATION	12803
CREW DATA MANAGEMENT	12985
PROXIMITY OPERATIONS	12802
IMU ALIGNMENT	12842
DEPLOYED PAYLOAD	16191
POSTINSERTION DEORBIT PREPARATION	16219
ASCENT/ORBIT/ENTRY POCKET CHECKLISTS	16873

ACKNOWLEDGMENTS

Major contributions to the Post Insertion Deorbit Prep Flight Procedures Handbook were made by the following individuals:

Post Insertion Procedures	Marianne Dyson
ATO Post Insertion Procedures	Marianne Dyson
FCS Checkout Procedures	Mi-Mi Lau
Deorbit Prep & Deorbit Prep Backout Procedures	Mi-Mi Lau

PURPOSE

The purpose of this document is to present the user with sufficient rationale and supporting information to give him a good understanding of the crew task for this mission phase. This handbook is intended primarily for use by flight crew members and training personnel as follow-on to Shuttle systems training. This document is devised so that it may become more general in nature, until a single multimission document evolves for the operational phase.

SCOPE

The PDP Procedures Handbook covers the mission phase as follows:

- Post Insertion
- ATO Post Insertion
- Nominal Deorbit Prep
- D/O Prep Backout

NOTE: This handbook is based on procedures in the final version of the STS-2 Post Insertion Deorbit Prep Checklist, Sections 1-6. It is recommended that these procedures and timelines be used in conjunction with this handbook.

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SECTION 1

OVERVIEW

1.1 POST INSERTION PROCEDURES

The post insertion phase of a flight contains the crew activities required to verify/configure systems to enable the Orbiter to remain in orbit. This phase begins immediately after the Orbiter has successfully achieved a safe orbit after OMS 2 and ends approximately 4 hours later. The operational capabilities of four systems must be successfully demonstrated for the Orbiter to remain in orbit. They are:

- Transitioning from the ascent (OPS 1) software to the on-orbit (OPS 2) software
- Operation of the payload bay doors
- Alignment of the inertial measurement units (IMU's) via the star trackers
- Purging of the fuel cells

The Orbiter and crew systems configurations are changed as little as possible from the ascent/entry configuration during this phase to reduce the time and activities required to configure for launch day deorbit in the event one of the four required systems capabilities is not functional. Additional activities need to be performed after the MCC/CREW GO for orbit operations to complete the configuration/activation of the Orbiter for on-orbit operations. These additional activities include deactivating the flight control system and doffing the suits.

1.2 ABORT TO ORBIT (ATO) POST INSERTION

Because of an 22-minute late OMS 2 burn required for the Abort to Orbit case, the nominal post insertion activities are begun 22 minutes later. The COAS Calibration is delayed for this case since it probably could not be completed before the end of orbital darkness. The MCC/CREW GO for orbit operations may occur prior to the completion of the four systems successful demonstration due to ground coverage. The crew will verify these systems are good before continuing with the on-orbit configuration/activation of the Orbiter.

1.3 NOMINAL DEORBIT PREP PROCEDURES

The deorbit prep phase contains the crew activities required to verify and configure the systems for the deorbit burn and entry. This includes the deorbit Flight Control System (FCS) checkout and deorbit prep activities.

1.3.1 Deorbit FCS Checkout

The deorbit FCS checkout activities are performed approximately 5.5 hours before the deorbit burn and take about 35 minutes to perform. These tests are performed primarily on equipment or systems supporting the FCS for deorbit and entry. The GNC OPS 8 and SM OPS 2 displays are used.

The FCS checkout is performed in two parts. The first part contains those tests requiring the auxiliary power unit/hydraulic (APU/HYD) system to be activated and shutdown. The second part contains the checkout of GNC equipment/systems.

Part 1 of the FCS checkout consists of activation, testing, and deactivation of the APU/HYD systems. When the FCS activation preparations are completed, the crew starts the FCS checkout by setting the event timer to count up and activate the APU. The checkout must be completed within 5 minutes or excessive APU consumables will be used. The testing consists of cycling the aerosurfaces to warm up the hydraulic fluid; checking out the response of the actuators, hydraulic motors, and hydraulic switching valves, and checking the secondary actuators to see if they will bypass (pop ports) when a hardover command is sensed. After the checkout is completed, the APU is deactivated.

Part 2 of the FCS checkout consists of tests or checks of the following systems and equipment.

- A self-test of the sensors using the SENSOR TEST and RGA/ADTA/RCS displays. The sensors tested are the MLS (microwave landing system), TACAN (tactical air navigation), RA (radar altimeter), AA (accelerometer assembly), RGA (rate gyro assembly), and ADTA (air data transducers assembly).
- A test of the primary and vernier reaction control system (RCS) jet drivers using the RGA/ADTA/RCS display. The test performs a continuity check (trickle current) of all 44 RCS jets.
- A controller and switch contact check using the SWITCH/SURF, SWITCHES, and CONTROLLERS displays. Both crewmembers manipulate the controllers and switches (FCS MODE/CH SWITCH, RHC, RPTA, SPDBK, THC, BODY FLAP, PNL trim switches, RHC trim switches, SPDBK takeover button, and mode/sequence pushbutton indicators (PBI's) to verify that the correct signals are reaching the computers on all the redundant channels for each controller or switch.
- A check of all the forward dedicated displays used during atmospheric flight using the FCS/DED DIS C/O display. Three checks are performed via item entries. One check is to see if values are properly displayed by sending I-loaded low and high values to the displays and confirming that the displayed values are correct. Another check verifies that the flags are driven to visibility. The third check tests the GPC interface to the FCS mode/Event Sequence lights.

1.3.2 Deorbit Preparations

The deorbit preparations are those activities performed before and after the deorbit checkout activities up to the deorbit burn preparations. The activities performed before the deorbit checkout begin about 6 hours before deorbit and take about 35 minutes to complete. The first activity is to have the CRT timer count down to the deorbit time of ignition (TIG) via the TIME display. The nominal TIG is 5/3:12 (MET day:hr:min). The CRT time will equal zero at the deorbit TIG burn.

The crew will also stow their personal hygiene articles, air sample, and aft COAS. At the ORR STDN site, the ground will notify the crew which APU to use in the FCS checkout, Part 1. The crew then configures the FCS and dedicated instruments for on-orbit checkout and entry after the Orbiter is maneuvered to tail to sun. The sun will be 20° below the -X axis so it will not interfere with the theodolite sightings during the closing of the payload bay doors. Before performing the FCS Checkout (discussed in section 1.3.1), the crew reconfigures the GNC DPS to OPS 8 from OPS 2.

After the FCS checkout, the crew will bypass and stow the radiators. The radiators are bypassed early to correct the center of gravity (c.g.) problem caused by the payloads. By TIG, approximately 2.5 tanks of water will be boiled off to move the c.g. aft. The crew will then reconfigure back to OPS 2.

In OPS 2, the crew performs crew system deactivation tasks, configures the pressure control system and water loop, closes the PLBD, and dons the operations biomed system (OBS) and the emergency escape suit (EES) for entry. When the payload bay doors (PLBDs) are closed, cooling is provided totally by the flash evaporators until the ammonia boilers are activated at 120 K feet.

An attitude maneuver to the top to sun attitude is performed for thermal conditioning of the wing glove. Approximately two daylight passes in the top sun attitude are required prior to entry for thermal conditioning. They are satisfied after the PLBDs are closed and after the IMUs are aligned.

The crew maneuvers the Orbiter to the IMU alignment attitude after the -Z star tracker is activated. The first of two IMU alignments is performed using two stars, one in each star tracker. After the first alignment has been accomplished, the Orbiter's attitude is changed so that a new star is positioned in each of the star trackers, and a second set of data is taken on this star pair to verify that the first realignment was performed correctly. If one of the star trackers is broken, the crew performs the alignments using a one star tracker procedure. If a good alignment is achieved, the IMU's drift-induced errors will be within the desired limits, even for a one orbit late deorbit case. If, for whatever reason, the IMU's cannot be realigned, deorbit will be delayed until an alignment can be accomplished. After the IMU's have been realigned and the alignment has been verified, the crew will maneuver back to the top sun attitude. The star trackers are then deactivated, and the star tracker doors are closed.

At this point, the crew performs the pre-ingress configuration. This includes preparing the main propulsion systems (MPS) for repressurization of the MPS at Mach (M) = 5, activating the Orbiter brake systems, repressurizing the space shuttle main engines (SSME) hydraulic system, and configuring the C/W system for deorbit and entry.

Prior to the OPS 3 transition, the normal jets are configured on and the vernier jets off. At TIG - 1:22 (hr:min), the DPS is reconfigured to the entry configuration (GNC OPS 3 and BFS) and the required telemetry downlink formats are loaded.

At TIG -1:10 (hr:min), the crew verifies the switches in the forward and aft station. Approximately 1 hour before deorbit, the crew ingresses their seats and dons their helmets. When completed, the crew is restricted to activities at the forward flight station.

Following seat ingress, the crew refers to the Entry Checklist for the deorbit burn and entry procedures.

1.4 D/O PREP BACKOUT

The GO/NO GO decision for the deorbit burn is made approximately 17 minutes before the burn (Entry C/L). If the decision is made to extend the mission for 24 hours, the crew will perform the activities in the PDP's D/O PREP BACKOUT section then go to the CAP's 24-HOUR EXTENSION procedure.

The PDP activities have the crew egress their seats and move to the aft station to reopen the payload bay doors. As soon as the payload bay doors have been opened and the radiators have been deployed and activated, the crew reconfigures the DPS for on-orbit. If the crew is unsuccessful in reopening the payload bay doors, the DPS and FCS will still be configured for entry, and all the crew needs to do is reingress their seats and prepare to deorbit one orbit late.

Having successfully opened the payload bay doors and deployed the radiators, the crew reconfigures the DPS and telemetry format load (TFL) for OPS 2.

The crew completes the D/O prep backout activities by reconfiguring the equipment/systems for on-orbit, doffing their suits, activating the teleprinter, unstowing the Flight Data File (FDF), and activating the star tracker. The crew then returns to the Crew Activity Plan, 24-HR EXTENSION.

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SECTION 2

DETAIL DISCUSSIONS

2.1 POST INSERTION PROCEDURE DETAILS

EVENT/CREW TASK

CONFIGURE GPC's FOR OPS 2 (BFS NOT ENGAGED)/PLT

TIME

00:53 MET

DISPLAY

GNC 0 GPC MEMORY
BFS, BFS MEMORY
GNC UNIV PTG
SM ANTENNA
SM 62 PCMMU/PL COMM

DISCUSSION

The first major activity of the post insertion phase is the reconfiguration of the GPC's from ascent configuration and software to on-orbit configuration and software. Preparations for this activity begin after the OMS 2 burn.

A Memory Configuration Table is provided at the front of section which shows what is I-loaded in each OPS.

Reconfiguration of the GPC's will be performed by the pilot and involves first loading entry software (GNC OPS 3) into GPC 3 before loading the on-orbit software (GNC & SM OPS 2) into the on-orbit GPC's. This demonstrates the capability to retrieve entry software from the mass memory and load it into a GPC, thus retaining a deorbit capability (GNC OPS 1 ascent software also has a deorbit capability) in the event a failure occurs during the transition from GNC OPS 1 to GNC OPS 2. The reconfiguration to the on-orbit configuration has GNC OPS 2 software loaded into GPC's 1 and 2 and SM OPS 2 software loaded into GPC 4. The BFS software is left alone in GPC 5. The remaining GPC (3) will retain the GNC OPS 3 previously loaded into it but will not be actively involved in control of the Orbiter.

REASSIGN FD GPC STRING TO GPC 2 IN MC 1

Since the freeze dried (FD) GPC will soon be taken to OPS 0, the string it is assigned in OPS 1 must be reassigned to another GPC to prevent alarms. The current OPS is 106, therefore a GNC, OPS 106 PRO is done after the GPC memory configuration table is updated to reassign the string and CRT that GPC 3 was commanding.

REASSIGN ALL STRINGS TO FD GPC IN MC 3

The item 3 execute brings up the I-loaded OPS 3 memory configuration table. It is then changed via item entries to reassign all strings, CRT's, and mass memories to GPC 3.

MODE FD GPC TO OPS 0

When any GPC is taken from RUN to STBY, it automatically downmodes to OPS 0. The reason the OPS 000 PRO is not used is that it would take the whole PASS set to OPS 0. Only GPC 3 is desired to be in OPS 0 in preparation for the freeze drying operation.

LOAD MC 3 INTO FD GPC

When PL is selected on any CRT, it requests an OPS 0 GPC, which in this case is GPC 3. Item 45 selects the desired memory configuration, item 46 selects the target GPC, and item 47 initiates the load without initiating an execution of the OPS 3 software. This demonstrates the capability to retrieve entry software from the mass memory and load it into a GPC, thus retaining a deorbit capability (OPS 1 also has a deorbit capability).

The procedure in * is an abbreviated troubleshooting procedure in case the freeze dry (FD) operation is unsuccessful. Since the load comes from the mass memory units (MMU's), the power on them is cycled to clear any problem and the FD is tried again. If it is still not successful, then it might be due to a GPC rather than an MMU problem. The strings are then reassigned in OPS 1 so that GPC 2 can be taken to OPS 0 and used for the FD GPC. If this works, then GPC 3 is declared failed and an alternate configuration is referenced. If it doesn't work, then both MMU's are declared failed and the ground will uplink the OPS 3 load.

SECURE BFS

The BFS was in OPS 1 until this time. Once the PASS set goes to OPS 2, the BFS does not receive any GNC data. The OPS 000 PRO puts the BFS in OPS 0 and terminates all of its GNC functions. The BFS gives up its command of the payload (PL) buses at this time. The SM GPC will be commanding them in OPS 2.

TRANSITION TO GNC OPS 2

Since the ORR site is coming up, the uplink is once again enabled. The uplink operations are manual until the SM GPC is active.

Item 1 brings up the I-loaded GNC OPS 2 memory configuration table which is verified by the crew. The OPS 201 PRO initiates the OPS 2 load and GNC software execution. When the UNIV PTG display shows up on the assigned CRT's (which must be in GNC major function to show the display), it means the load is complete.

TRANSITION TO SM OPS 2

The OI PCMMU switch is taken to PCM so that the ground will receive SM downlist as soon as the SM GPC is active. GPC 4 has no CRT's assigned to it since it is in OPS 0. The SM major function is currently an unsupported OPS, so it calls an OPS 0 GPC. A forward CRT is assigned to GPC 4. Item 1 brings up the I-loaded SM OPS 2 memory configuration table which is verified by the crew. The OPS 201 PRO initiates the OPS 2 load and SM software execution. When the SM ANTENNA display shows up on the assigned CRT's (which must be in SM major function to show the display), it means the load is complete.

The DPS UTILITY display is called so that the automatic uplink control can be enabled. The uplink is cycled on only for S-band sites to prevent any unauthorized commands reaching the Orbiter.

RECONFIG GPC's

The BFS (GPC 5) is taken to STBY. It is already in OPS 0. It can be engaged from STBY if necessary though it will not have a current state vector (since it will not be monitoring the PASS in OPS 2). To prevent the BFS from being engaged, the output switch is taken from backup to normal.

The output switch of GPC 4 is taken to terminate to ensure it will not be able to talk on the flight critical buses. It will maintain a listen capability and remain part of the redundant set.

The FD GPC (3) is taken to STBY. It is already in OPS 0. Going to STBY saves power and does not disturb the software load.

RECONFIG CRT's

The GPC/CRT 03 is done because CRT 3 will be powered off and not used for on-orbit operations. Only three CRT's can be assigned to the PASS set at any given time, so CRT 3 was chosen to be deassigned. It was chosen in preference over the others because it is also the BFS CRT.

Once CRT 3 is deassigned, CRT 4 is assigned in its place to both GPC's 2 and 4.

LOAD ORBIT TFL

The telemetry formats for high data rate (HDR) and low data rate (LDR) will be changed from formats for the ascent configuration (129 and 002) to formats for the on-orbit configuration (161 and 163). The telemetry format load (TFL) for the HDR on-orbit configuration (161) will be executed before loading the OPS 2 SM software in order to get telemetry data on SM during the loading. The TFL for the LDR on-orbit configuration (163) is then loaded. At the end of this procedure, the DFI PCM recorder will be switched from the continuous to the high sample mode. The recorder was required to be in continuous record for the OMS 2 burn plus 15 min after the burn.

EVENT/CREW TASK

SEAT EGRESS/BOTH

CUE

00:56 MET CDR & 01:05 MET PLT

DISPLAY

N/A

DISCUSSION

Initially, the commander monitors the GPC reconfiguration activity by the pilot but then starts the seat safing and egress procedures. The latter part of this activity is the first time the crew has access to the aft flight deck (AFD) or middeck controls.

EVENT/CREW TASK

MNVR TO PLBD OPENING ATTITUDE/PLT

TIME

01:00 MET

DISPLAY

GNC UNIV PTG

DISCUSSION

After the GPC reconfiguration and the TFL, the pilot loads and executes an auto attitude maneuver with the vernier RCS to place the Orbiter in the payload bay door (PLBD) opening attitude. MCC will give a GO to use the VRCS if they are above 130 deg required for use. The crew has no visibility into these temps. This auto maneuver could not be done until the GNC OPS 2 software was loaded into the GPC's. The PLBD opening attitude is an inertial attitude with the PLB (-Z axis) pointing at the earth. The target ID (2) specifies the center of the earth. Although this value is I-loaded, it is checked since this is the first time the UNIV PTG display is called. The body vector specifies the -Z axis which will be pointed at the earth, and the omicron specifies a nose forward attitude. DAP A is nominally used throughout post insertion. A table at the front of the section shows what deadbands and rates are I-loaded in both DAPs. The pilot then starts his seat safing and egress procedures.

EVENT/CREW TASK

AFT STATION CONFIGURATION/CDR

TIME

DISPLAY

01:04 MET

N/A

DISCUSSION

The aft station configuration is divided into three main parts. Part one includes switches that need to be configured as soon as possible after seat egress. Part two includes less time critical activities, and part three is the reaction jet driver configuration which deactivates all the primary jet drivers. A detailed discussion follows.

ASAP AFTER SEAT EGRESS

The cabin vent cb's were launched closed to allow a possible overpressurized cabin to vent if needed. Once in orbit, these cb's are opened to prevent an accidental venting (switch on L2 is easily bumped during seat egress).

The vernier driver power is off for ascent for leak protection. The vernier heaters were on and should have the jets up to proper temperature ($\sqrt{130}$ deg) by this time. This switch needs to be activated ASAP so the verniers can be used for the PLBD opening maneuver.

The fuel cell water line heater is off for ascent to save power. If the power level should be very low, these heaters are needed to prevent freezing.

The supply water crossover valve is opened at this time to provide water from tanks C - F to the flash evaporator system. Tank B is nearly depleted, and the outlet from tank A is closed to prevent contamination of crew drinking water. If this valve were not opened, tank A would try to backflow water through its inlet valve through tank B to the flash evaporators. The water pressure would be too low to provide adequate cooling and an EVAP OUT T HIGH message would result. The crew could switch to flash evaporator controller B which would also provide water from tanks C - F, but controller A is nominally used in conjunction with the crossover valve opening.

The RCS/OMS heaters were off for ascent to prevent a power spike should they all come on at once. The system should be warm until this time anyway due to the prelaunch purge with warm hydrogen.

Water tank A was launched at cabin pressure ($\sqrt{14.5}$ psi) to ensure that the byproduct water from the fuel cells would not backflow. However, as tank A becomes full, it will place a lot of pressure on its bladder, which only has cabin pressure on the other side. To prevent a possible rupture, the tank is pressurized to $\sqrt{31}$ psi as soon as orbit is reached.

ON-ORBIT CONFIG

This section is mostly concerned with configuring the communication to headsets which are much more comfortable. Also, S-band equipment which was powered for launch in case of a contingency is now turned off.

'Interim' wireless headsets will be used for several flights. These headsets consist of two parts; one attached to the crewmembers' right leg, and one attached to an audio panel via a short cable. The part attached to the audio panel uses 28 V DC power, and the part attached to the crewmember uses batteries. These batteries must be changed ~ every 8 hours. There is no power difference between transmitting and non transmitting. There are 21 batteries available, enough for 16 hours per day for 5 days plus one spare. The old (non wireless) headsets will be used during the sleep period or if the wireless headsets fail.

The APU gas generator heaters were launched in the A-AUTO position to support a contingency. In this position, the heaters are thermostatically controlled. They were probably not needed since the APUs were on during ascent. As the APUs cool down (up to 11:15 MET), it is desired to disable these heaters to prevent them from coming on. This will help prevent bubble formation in the fuel pump area which was detected on STS-1. If the temps get too low, the crew will return the heaters to A-AUTO.

The payload recorder is turned on for the ground to check the tape position prior to its first use.

On R15, the cb's are closed so the comm can be used in the middeck later and so the TV cameras, monitors, and floodlights will be available for PLBD and other orbit activities. These cb's will remain closed through entry.

CRT 4 will be used for PLBD operations so is activated now.

The OEX recorder was on for ascent to record ACIP data. It will not be used during post insertion so is turned off.

The DFI recorders used for ascent are turned off. This is a considerable power savings.

The aerosurface thrust vector control (ATVC), engine interface unit (EIU), and main engine controller (MEC) are not needed for orbit operations and are thus turned off. The ATVC power should not be removed until the engines are stowed (supplies power to drive the hydraulic actuators), which usually occurs in the Ascent Post Burn time frame. This also applies to the EIU. The 2-sec delay on the MEC turnoff is to prevent an MIA 'burp,' a software constraint.

The aft display driver units are needed to supply power to the aft RHC, THC, and ADI.

RJD CONFIG

Once the verniers are active, all the primary RCS drivers are turned off to provide protection against erroneous commands firing jets.

EVENT/CREW TASK

RADIATOR ACT/PLT

TIME

01:15 MET

DISPLAY

N/A

DISCUSSION

This activity involves activating radiator controller A to control both Freon loops in the AUTO mode and configuring the radiator bypass valve for auto operation. After these switches are configured, the radiator bypass valve will be automatically driven by controller A from the bypass position to the flow position allowing flow through the radiators. This is done before opening the PLBD's to allow the radiators to be flowing Freon before they start cooling down (after the PLBD's are opened) to prevent an initial surge of cold Freon from the radiator from possibly causing the controller to automatically drive the radiator bypass valve to bypass. It also reduces the thermal load on the flash evaporator system (FES), reducing the water usage rate.

The procedure in stars is provided in case the tb stays in BYP or sticks in bp. This indicates the bypass valve did not drive to full rad flow position or the tb itself is failed. By manually driving the valve to RAD FLOW, the valve and tb can be checked. If the tb remains BYP or bp, it is not desirable to select the alternate RAD CNTLR. The reason is that part of its startup sequence is to attempt to drive the BYP valve to full bypass, which might cause an already 'sticky' valve to drive permanently to bypass. If this happens, that radiator is then useless for cooling.

EVENT/CREW TASK

THEODOLITE SETUP/ACTIVATION/PLT

TIME

DISPLAY

01:19 MET

N/A

The theodolite is an optical sighting device used to accurately determine PLBD deflections. It must be unstowed from its middeck locker (too large for the flight deck) and connected to its battery via a cable. It is mounted in the aft window and calibrated.

EVENT/CREW TASK

CONFIGURE PLBD's FOR OPERATION/CDR

TIME

01:20 MET

DISPLAY

SM PL BAY DOORS

DISCUSSION

The preparations for PLBD operations begin with configuring switches which provide power to the aft station lights (MNC) and the payload bay flood-lights. The TV cue card is used to set up the closed circuit TV (CCTV) and video tape recorder (VTR), which will be used to record the PLBD activities.

AUD CTR PL BAY OUTLETS I/OM A is turned on to provide voice with the VTR.

A lengthy CAUTION note is provided to aid the crew should a computer or PLBD problem occur during the upcoming activities. The actions described for PLBD anomalies are an abbreviated list from the Flight Rules.

SM OPS 202 is nominally used for PLBD operations. However, if the SM GPC fails, the BFS SM 63 display can be substituted for the SM PL BAY DOORS display with no loss of capability as far as door operations are concerned.

EVENT/CREW TASK

OPEN/CLOSE EACH LATCH GROUP/PLT

TIME

NOT SCHEDULED FOR STS-2

DISPLAY

SM PL BAY DOORS

DISCUSSION

The PLBD latch test is performed by the pilot from the MS station CRT (4) using the SM PL BAY DOORS display configured to the manual mode and the switch control on panel R13. This test is not required unless there has been a configuration change since the previous flight or a new vehicle is being tested. The test involves selecting each group of latches individually via the CRT and cycling them to the open position and then back to the closed position. This demonstrates the operation of each of the eight latch groups while the remaining seven groups stay closed. The opening and closing times of each latch group are measured, using a stop watch, and recorded. This aids in determining proper operation of the latches, especially whether or not both motors are operating. If only one motor is operating for the closing sequence of a latch, the latch will not be re-opened and the flight will be terminated. This is because, if the latch were left open with only one motor close capability, a subsequent single failure (the motor) would prevent closing the latch and would require an EVA to close the latch. This assumes that all latch groups are designated as critical and thus are required to be closed for entry. While the pilot is performing the latch tests, the commander is adjusting the PL bay CCTV cameras and VTR, and observing the operation of the latches and door centerlines in the payload bay.

EVENT/CREW TASK

THEODOLITE OPS

TIME

DISPLAY

01:25 MET

N/A

The detailed procedure for the theodolite is located in the back of the section. The handrail targets are used first for calibration. There are three targets on each side of the PLB on the longerons. There are six targets on each side of the PLBD centerline (Reference Theodolite Target Location Diagram). The target pad is in groups according to execution in the timeline. The horizontal and vertical angles are recorded at each sighting.

EVENT/CREW TASK

PLBD OPEN/CLOSE TEST/BOTH

TIME

01:33 MET

DISPLAY

SM PL BAY DOORS

DISCUSSION

This test involves partially opening each PLBD, then closing it and comparing the time to open with the time to close. If the times are not the same, it would indicate a motor failure or loss of power. The crewmember will time the door openings and closings. There is no need to fully open the doors since a comparison is all that is required.

Before the starboard door is closed, the crewmember does a check to see which centerline latch will make first contact. This indicates whether or not ascent thermal conditions caused a gap or overlap condition in the doors. This data is recorded on the Launch Day NO GO Criteria Diagram.

EVENT/CREW TASK

UPLINK/DOWNLINK/MCC

TIME

Variable

DISPLAY

GNC 1 DPS UTILITY

Throughout the post insertion timeframe, uplinks and downlinks are scheduled according to ground station coverage. Some of these are time constrained and so are explained here.

The first S-band site after OPS 2 is achieved is used to send Table Maintenance Block Updates (TMBU), update Deorbit targets for launch day opportunities, and configure the S-band to LO mode.

TMBU are used to change C&W parameters or switch onboard antenna selections. The antennas are changed by deleting sites the GPC is pointing at.

The S-band to LO mode is sometimes done over IOS in OPS 1. S-band was in HI pwr mode for ascent due to interference of the SRB plume and ET with the signal. The next set of S-band sites are used to uplink the Orbiter state vector, RCS quantity I-loads, variable parameters, and Entry REFSMMATs.

The RCS quantity is uplinked to provide the correct onboard data driven by the GNC GPC. I-loaded values are used until this uplink. (The BFS performed this function in OPS 1.) This uplink is desired ASAP after OPS 2 is achieved.

Variable parameters are chosen by the ground to view data not otherwise on the downlist. An example for STS-2 are the input parameters which determine the criteria for RCS jet selection.

The Entry REFSMMATs (reference matrices) are needed prior to the IMU to IMU alignment called DESIRED REFSMMAT UPDATE. One S-band site 'backup' to the scheduled opportunity is provided.

TV downlink is also shown for any available site (dashed lines) during PLBD operations. GDS/MIL is not used for TV during this time due to dumping ASC data from the OPS recorder.

EVENT/CREW TASK

AUTO OPEN PLBD's/BOTH

TIME

02:08 MET

DISPLAY

SM PL BAY DOORS

As part of Flight Test Requirement (FTR) 251, a demonstration of the automatic PLBD opening sequence is specified. The crew will initiate the sequence via CRT 4 and the switch on R13. They will monitor the display to verify the drive times are nominal. The whole sequence should take ~3 min 40 sec.

EVENT/CREW TASK

----- RAD DEPLOYMENT AND VERIF/PLT -----

TIME

02:17 MET

DISPLAY

SM 88 APU/ENVIRON
THERM

DISCUSSION

After the PLBD testing is complete, the pilot remains at the aft flight deck and unlatches and deploys the active thermal control subsystem (ATCS) radiators in the PL bay using the control switches and tb's on panel R13. The radiator latch and deployment mechanisms are not cycled because unlatching and deployment of the radiators is not required for successful on-orbit operation. (Nondeployed or stowed radiators lose approximately 20 percent efficiency.)

If a radiator deploys on a single motor, it will be stowed and the good radiator will be redeployed. This is to protect against a second motor failure preventing a deployed radiator from being stowed. A table is included (in stars) which shows which AC bus controls which latches. There are two sets of latches, but the LATCH motors are three-phase motors (three cb's need to be opened to remove power from a motor since the motors will operate on one phase), whereas the DPLY motors are two phase.

The PLB floodlights, TV cameras, monitors, and VTR are deactivated at this time. It is important that the VTR be stopped since there is a limited amount of film available (30 min/cassette). The ground can command the TV off if necessary to prevent overheating of the cameras.

The pilot moves to the forward station and monitors the radiator controller out temperatures for each of the two Freon loops, via the APU/ENVIRON THERM display on CRT 1, for a drop to below 60 deg F. This indicates that the Freon in the radiators is flowing and providing cooling (this temperature measurement is taken before the Freon reaches the evaporators). When this temperature drop is confirmed, the pilot turns the HI LOAD evaporator off (control is at forward station). The HI LOAD evaporator duct heater is turned off approximately an hour later.

EVENT/CREW TASK

PALLET/FILE HTR/OCE ACT

TIME

02:22 MET

DISPLAY

SM 90 OSTA-1 PALLET
SYS
SM 91 OSTA-1 EXP

RMS/PALLET AC PWR ACT

The AC 3 PL 3 ϕ cb must be closed to provide power to the pallet Freon pumps. The AC 1 and AC 2 RMS cb's provide power to the indicators which will be used to check the JOINT temperatures. (It is assumed 013 ESS 3AB MNC CONTR cb is closed to provide pallet power.)

PALLET ELECTRICAL SUBSYSTEM

Payload primary MNC power is needed to supply power for the heaters on the pallet.

The Freon flow proportioning valve is taken from ICH to PL HX to increase the Freon flow to the pallet since payloads will soon be activated.

Power is then applied to the pallet system and experiment switches.

The SM, I/O RESET is needed to reestablish communication between the FMDM and the SM GPC.

PALLET ATCS ACT

Spec 90 is used to turn on the pallet Freon pumps and check the pump pressures are in the nominal range. This needs to be done soon after the PLBD's are open.

FILE HTR ACT

As soon as possible after the PLBD's are open, the FILE heater is activated to prevent the package from getting too cold (protecting the film is especially important). Spec 91 is used to do this.

OCE ACT

Continuing on Spec 91, the OCE power is turned on in order to activate the OCE heaters and prevent the instruments from getting too cold. This needs to be done soon after PLBD opening.

EVENT/CREW TASK

PWR-UP RMS TO TEMP MODE

TIME

02:26 MET

DISPLAY

SM 94 PDRS CONTROL

RMS TEMP MODE

Prior to this activity, the cb's on MA73C:E and F for AC 1 and AC 2 RMS must be closed. The RMS Temp Mode means the RMS power is in primary and the MCIU is active.

When the RMS power is taken to PRI, a master alarm (MA) is generated because I/O is off. When the display, Spec 94, is called up, the MA and GPC data lights come on due to the I/O still being off and no data buses available. The next step is to turn on I/O via item 5.

Taking the SAFING switch to CANCEL starts the RMS MCIU through its initiation cycle. The data buses are made available, and hence the GPC DATA light goes out.

PORT TEMP is chosen so that the arm temperatures can be monitored on the indicators. Each JOINT of the RMS is checked to be within the nominal temperature range. If not, the crew records the temperature in the blanks provided. The JOINT switch is put back into CRIT TEMP to blank the indicators and thus save power.

RMS SHOULDER BRACE RELEASE

The RMS shoulder brace is secured for launch. Once it is released, it remains that way throughout the flight (including entry). If AC 1 ϕ A were lost, the brace could not be released and would severely limit RMS operations. The brace is released as soon as practical after orbit in case thermal effects could cause it to 'stick' later or AC 1 fails.

The RMS SEL switch is off as part of the Temp Mode. If it were in PORT, it would allow the capability to move the RMS and put it in IDLE Mode, which uses more power.

EVENT/CREW TASK

COAS CAL/CDR

TIME

02:29 MET

DISPLAY

GNC 20 DAP CONFIG
GNC 22 S TRK/COAS

DISCUSSION

While the pilot is at the aft station, the commander is preparing for the forward station COAS calibration, which must be performed while in orbital darkness. This involves unstowing and mounting the star sighting COAS in the forward (+X) position.

The star trackers (ST's) are turned on at this time for warmup so that they will be ready after the COAS CAL. The commander initiates an auto maneuver from the PLBD opening attitude to a new inertial attitude such that navigation stars will be in the +X COAS FOV. This maneuver is optimized by making the COAS CAL attitude as close as possible to the attitude for the first ST data takes.

The GNC 20 DAP CONFIG display is used to change the vernier rotation compensation from 0 (I-loaded) to .003. This allows the DAP to automatically damp out oscillations due to cross coupling and thus help the crewmember obtain a more accurate sighting. After the CAL, the compensation is returned to 0 to conserve fuel.

After configuring the COAS portion of the STRK/COAS display, and enabling the RHC (FLT CNTLR PWR-ON), the commander maneuvers the vehicle so that the star passes through the center of the COAS. When the star passes through the center of the COAS it is marked by depressing the ATT REF pb. The +X Δ bias of the COAS is then computed and displayed on the CRT, recorded, and updated by the commander. The commander verifies the accuracy of the mark by again maneuvering and marking the star at the center of the COAS. The +X Δ bias is computed again and should be no greater than 0.12 deg. If it is >0.12 deg, the new +X Δ bias is updated and the verification process is repeated up to two additional times. DAP control is then returned to auto vernier control and the RHC is safed.

EVENT/CREW TASK

STAR TRKR SELF-TEST/DOOR OPEN/CDR

TIME

02:43 MET

DISPLAY

GNC 22 S TRK/COAS CNTL

DISCUSSION

The star trackers are self-tested before being used to take star data using the STRK/COAS CNTL display. They can be self-tested right away as they were powered during the COAS CAL activities (they require 15 min warmup). If either ST fails the self-test, it will be retested once. No matter what the results of the self-test are, both ST's will be used to initially take star data since failing the self-test is not a complete criterion for declaring an ST failed. (Out-of-limit values for ANG ERR or IMU torquing angles are then used to declare an ST failed.)

After the self-test, the ST doors are opened via control switches on panel 06. Both door control systems (1 & 2) are run simultaneously (each system operates both doors), and the door opening times are monitored to confirm dual system operation (8 to 12 sec). Doubling that time for a door opening would indicate a failure of one of the system motors for that door. An ST door that has only one operational control system (motor), however, will still be operated (opened/closed) in the same manner as a fully operational door with two systems since closing the ST doors is not a mandatory requirement for entry.

EVENT/CREW TASK

DESIRED REFSMMAT UPDATE

TIME

02:46 MET

DISPLAY

GNC 21 IMU ALIGN

To optimize the acceleration sensing capability of the IMU's, the IMU's are oriented with respect to the Orbiter, one way for launch and another way for entry. This procedure results in the entry orientation.

After orbital insertion, the ground uplinks the entry REFSMMAT's to the active PASS GPC's (not the freeze dried or BFS). When an IMU to IMU alignment is done, two of the IMU's will physically have their platforms moved to a position which corresponds to the uplinked reference matrices. The third IMU, called the reference IMU, has the same orientation for both launch and entry and is therefore not moved. A simple diagram illustrates the IMU to IMU alignment:



The IMU's are aligned regularly to remove errors which may occur due to thermal or mechanical stresses. The IMU to IMU alignment does not null the errors, in fact it may contribute some of its own. The IMU star alignment has fewer sources of error; therefore, it follows the IMU to IMU alignment. Since another IMU star alignment will be done at a later time, the star alignment also provides a base to calibrate the IMU drift rates. This would not be true if the IMU to IMU alignment were done after the star alignment.

EVENT/CREW TASK

SWITCH APU COOLANT SYS

TIME

DISPLAY

02:52 MET

N/A

The APU's (gas generator bed) need to be cooled to support a nominal restart. The cooling is provided by system A from APU shutdown (Ascent Checklist) until this time. ~2 hr 45 min is required of each system to cool the APU's, and 3 hr is the maximum time for one (either A or B) system. The B system will be used until it is turned off in the CAP. Note that a hot restart of the APU's is available since only about 3.5 min of cooling (GG below ~825 deg) is required for that capability.

EVENT/CREW TASK

IMU STAR ALIGN/CDR

TIME

02:54 MET

DISPLAY

GNC 22 S TRK/COAS CNTL
GNC 21 IMU ALIGN
GNC UNIV PTG

DISCUSSION

Once the proper attitude is attained, the crew verifies that the star table is clear and puts the star trackers into the active mode (ITEM 3, 4). Star data acquisition is performed in the auto star select mode ($\sqrt{\text{REQD ID ITEM 11, 12 (two) -0}}$). The star tracker software selects a star in the FOV and puts it in the table. The Δ ANG's indicate the difference between where the ST hardware found the stars and where the software thought they should be found.

The crew monitors the S TRK/COAS CNTL display, records the Δ ANG's in the log, and checks that the ANG ERR is within limits. The ANG ERR indicates the difference between what the two star trackers measured and what the real angle is between the two stars. If this error is large, more data is taken to help discover which ST is most in error.

Next, the IMU ALIGN display is used to check the ANG ΔX , ΔY , ΔZ for the reference IMU (the one the other two IMU's were torqued to in the DESIRED REFSMMAT UPDATE) to see if they are within the limit. If they are, then the ANG ΔX , ΔY , ΔZ are recorded in the log, and the IMU's are torqued. The alignment is complete when the * at ITEM 16 goes away.

If the ANG ΔX , ΔY , ΔZ are not within the limit, it probably indicates one of the ST's is bad. If one of the ST's failed the self-test earlier, it is assumed bad, and the One Star Tracker procedure (ONE STAR TRKR STAR DATA AQUISITION and IMU STAR ALIGN PAD 2nd ATTITUDE) is used to take star data. If both ST's passed the self-test, new star data is taken with both active. If this data shows one of the ST's has a large Δ ANG, it is assumed the bad ST, and more data is taken using the One Star Tracker procedure. If all this results in the ANG still above the limit, the ground will advise the crew of the next action while the IMU's remain nonaligned.

EVENT/CREW TASK

RESET C/W / PLT

TIME

02:55 MET

DISPLAY

NONE

DISCUSSION

These procedures enable C/W parameters that were inhibited during launch in order to prevent unwanted C/W alarms. The procedures also inhibit and change limits of parameters for systems that were active only for launch (e.g., MPS). The OMS fuel and pressure limits are changed from the higher BFS limit (288 psi) used for ASC to the lower PASS limit (284 psi).

EVENT/CREW TASK

ACTIVATE FC PURGE HTR/PLT

TIME

02:57 MET

DISPLAY

N/A

The fuel cell purge heater is activated 15 min prior to the Auto Fuel Cell Purge Test so the vent line temperatures will be high enough to allow the purge to start. The temperatures initially are between 50-120 deg and can rise up to 350 deg during heater operation.

EVENT/CREW TASK

POST S TRK/IMU RECONFIG

TIME

DISPLAY

03:06 MET

N/A

The -Z ST is turned off since it will be pointing at the earth in the nominal attitude. It also saves power.

EVENT/CREW TASK

MNVR TO -ZLV, Y-POP ATTITUDE

TIME

03:08 MET-

DISPLAY

GNC UNIV PTG

After the IMU alignment is complete, the Orbiter is taken to its nominal bay to the earth orientation required by the payloads. The target ID (2) specifies the center of the earth, the Body Vector specifies the -Z axis to be pointed at the target, and the Omicron of 180 specifies nose forward.

EVENT/CREW TASK

FUEL CELL AUTO PURGE TEST/PLT

TIME

03:11 MET

DISPLAY

SM 68 CRYO/FUEL CELLS

DISCUSSION

The capability to purge the fuel cells is a requirement for continuing past the launch day opportunities and, thus, must be demonstrated before the 3:20 MCC/CREW GO for orbital operations. This involves initiating an automatic fuel cell purge during ground station coverage so that the MCC, in addition to the crew, can monitor it. The fuel cell purge line heaters are manually turned on earlier to be sure that the vent line temperatures will be high enough to allow the purge to start when the auto sequence is initiated. The crew verifies successful purging by monitoring O₂ and H₂ reactant flow increases for each fuel cell on the CRYO/FUEL CELL SM display on CRT 4 next to the purge controls on panel R12.

The switches are left in GPC so that the SM GPC will command the heaters off 55 min after the purge. They are nominally left in GPC after that in case of a Freon loop failure which would require a continuous fuel cell purge to keep the fuel cells cooled. The GPC position allows the ground to command the purge.

EVENT/CREW TASK

----- CONFIG CONTROLS FOR ON-ORBIT/BOTH -----

TIME

03:22 MET

DISPLAY

N/A

DISCUSSION

After the GO for orbital operations, the Orbiter systems that were left in an ascent/deorbit configuration up to this time are reconfigured to support orbital operations. The CDR configures the flight deck equipment while the PLT configures the middeck items. The PLT can then begin suit doffing.

At this time, the IECM is taken to POSITION 1. This activates the mass spectrometer. At least an hour must have elapsed between PLBD opening and this activity to allow for outgassing.

The ACIP heater is turned on at this time. The supply water crossover valve which was opened at 1:05 MET is now closed. This is to isolate tanks A and B from C, D, E, and F. Tank B has been filling up with fuel cell water and is now feeding the flash evaporator system.

Water loop 1 is taken to GPC, B, which is the nominal on-orbit configuration. This allows it to cycle on and off while the ground monitors the limits. The limits are set later to prevent SM alerts waking the crew during the sleep period.

Since the high-load evaporator was turned off earlier and the duct is now baked out, the heater is turned off.

Cryo tank 3 heaters were off until this time, to save power since tanks 1 and 2 are supplying the fuel cell reactants. Tank 3 is set at a higher pressure so that once its heaters are on, it will be used first to satisfy a DTO.

The other switches on the flight deck were on to support a contingency deorbit. Since the GO for orbit has been given, these switches can be turned off. These include the switches on F6/F8, L2, 05, 07, 08, 09, 014, 015, 016, and C9.

Circuit breakers on ML86B row A and B are closed to provide power to the waste water supply and dump line heaters used when venting the commode. The floodlight cb's on row F and G are closed so the crew can choose whatever lights are convenient. The EMU cb's on row E are closed in case that equipment is needed for a contingency.

Cryo tank 4 cb's are left open since there is no tank 4 set for STS-2.

EVENT/CREW TASK

SUIT DOFFING/BOTH

TIME

03:27 MET

DISPLAY

N/A

DISCUSSION

The removal of EES suits and associated Crew Systems equipment is delayed until after the GO for orbital operations since they would have to be put back on for a contingency deorbit on Flight Day 1.

EVENT/CREW TASK

VAC VENT, FDF, AND DOSIMETER CONFIG/PLT

TIME

DISPLAY

03:50 MET

N/A

DISCUSSION

After the GO for orbital operations, stowed equipment that is required to conduct on-orbit testing (DTO's & DSO's) and Orbiter operations is unstowed and deployed. Some of the first equipment deployed is the radiation dosimeter pouches which are deployed in both the flight deck and the middeck to support DSO S232.

The remote switching cord was attached to the aft A1 PCMMU switch to allow a manual switchover during ascent if required. At least one PCMMU is required for orbit.

The Ascent Checklists are no longer needed, so are stowed out of the way.

EVENT/CREW TASK

TELEPRINTER ACTIVATION/CDR

TIME

03:51 MET

DISPLAY

N/A

DISCUSSION

The teleprinter allows the ground to send written messages to the crew on orbit. It is about the size of a Vu-graph machine and stowed in the mid-deck. It is powered through MNC DC utility outlet on A11 via a cable connection. All switches for Air to Ground 2 (A/G 2) are taken to Receive (RCV) so the teleprinter uplink will not be interrupted by a transmission. If the crew tries to transmit on A/G 2, they will hear a tone. The teleprinter is active through the Mission Station (MS) audio, and thus MS cannot be used by the crew.

EVENT/CREW TASK

MIDDECK CONFIG/PLT

TIME

- 03:55 MET

DISPLAY

N/A

DISCUSSION

At this time, the theodolite is stowed and the commode (WCS) is readied for use. The crew uses this time to 'set up housekeeping' and freshen up before a busy bunch of crew activity.

EVENT/CREW TASK

CONFIGURE CABIN TEMP CNTL/CDR

TIME

03:56 MET

DISPLAY

N/A

DISCUSSION

The cabin temperature controller arm is stowed in a pin bag to preclude damage during ascent vibration.

This concludes the post insertion phase of the flight. The Crew Activity Plan takes over from here.

2.2 NOMINAL DEORBIT PREP PROCEDURE DETAILS

The following pages contain detailed discussions of the Nominal Deorbit Prep Procedures. The sequence and time of each activity are based on the 'Final' edition of the STS-2 PDP document.

EVENT/CREW TASK

CRT TIMER SETUP/PLT

TIME

TIG -6:05

DISPLAY

GNC 2 TIME
SM 2 TIME

DISCUSSION

In order to make the deorbit timeline sequence independent of the selected deorbit opportunity, the generic time base of TIG -X time will be used. At the beginning of the deorbit prep day, the crew enters the deorbit TIG time into the GNC 2 and SM 2 TIME displays via item 17. The nominal deorbit TIG time is 5/3:12 (day/hr:min) MET.

The software will calculate the time remaining to deorbit TIG (T) by one of the following formulas:

If the deorbit TIG \geq current MET time,
 $T = \text{deorbit TIG} - \text{current MET time}$

If the deorbit TIG $<$ current MET time,
 $T = 24 \text{ hrs} + \text{deorbit TIG} - \text{current MET time}$

T will be software loaded into the CRT timer. The CRT timer will then count down to zero (occurs at the burn). After the burn, it will count up.

The only way to reset the timer in OPS 3 is via items 10, 22, and 23 in the MNVR display.

EVENT/CREW TASK

APU STEAM VENT HTR ACT/PLT

TIME

DISPLAY

TIG -6:04
TIG -2:13

N/A

DISCUSSION

Heaters associated with the water boiler steam vent are required to be turned on before APU activation. This is accomplished by turning the BLR CNTLR PWR/HTR to A and BLR CNTLR to ON. This action allows the heaters to warm up to at least 130°. The water boiler will then give the APU a ready-to-start signal (tb-gray).

Since the FCS C/O, Part I only uses one APU, the heaters are only required to be on ~30 minutes (TIG -6:04) before activating the APU.

At TIG -2:13, the heaters are turned on 2 hours before all 3 APUs are activated.

EVENT/CREW TASK

ENTRY STOWAGE/BOTH

CREW SYS DEACT/BOTH

SEAT/POS CONFIG/BOTH

WCS DEACTIVATION/CDR

SECURE AFT DECK/BOTH

TIME

DISPLAY

TIG -6:03
TIG -4:37
TIG -4:25
TIG -2:30
TIG -1:04

N/A

DISCUSSION

The crew will perform as many physical activities (stowage, connection, deployment, verification, et cetera of equipment) as possible before suit donning and seat ingress. If the crew performed the top three activities with their suits on, they would need time to 'cool down' again.

The entry stowage and crew systems deactivation consist of stowing and reconfiguring various articles/equipment for crew safety during entry. The stowage procedures are contained in the Crew Systems Checklist. Detailed descriptions of the equipment are contained in the Shuttle Flight Operations Manual (SFOM) Volume 12.

The entry stowage consists of stowing personal hygiene articles, filling the air sampler, and verifying the aft COAS is stowed.

The crew systems deactivation includes the following activities:

- Configure the cabin temperature controller to full cool after the regulator is turned off (required before suit donning).
- Remove and stow the CO₂ absorbers.
- Stow/unstow/install FDF articles/radiation instruments (dosimeters).
- Stow fwd/aft shades/filters.
- Install the overhead shades.
- Stow the 35mm camera, 70 mm cameras, and spot meter.

The seat/portable oxygen system (POS) includes the following activities:

- Transfer the helmet bags from the middeck to C2.
- Configure the seats by removing unnecessary Velcro and clearing the straps and belts from the seating area.
- Verify both POS, located on left side of the pilot's seat, are stowed so that they may be used post landing.
- Open the seat O₂ so the pressure from the seat's POS to the helmet is reduced from 900 to ~60 psi. When the suit is donned, the pressure will be reduced from ~60 psi to ~1.5 in. of H₂O.

The activity of deactivating the Waste Collection System (WCS) is performed as late as possible.

The securing of the aft deck consists of stowing the vent hose extension, verifying the aft modular lockers (A16, A17) are secured, the suit fans are on, and the aft lights are off.

EVENT/CREW TASK

DFI WB AUTO CAL/CDR

TIME

DISPLAY

TIG -6:00 MET

N/A

DISCUSSION

The DFI wideband mission recorder is automatically calibrated before operation during the deorbit burn and entry (EI through rollout). Other planned calibrations occur on launch day and post landing.

EVENT/CREW TASK

AUTO MNVR TO TAIL TO SUN/CDR

TIME

TIG -5:55

DISPLAY

GNC UNIV PTG

DISCUSSION

The auto maneuver to tail to sun attitude is established upon completion of the DFI calibrations. This attitude, which is executed via the UNIV PTG display, is a benign attitude for wing glove conditioning (cools the Orbiter's bottom) and PLBD problems. The sun will be 2° below the -X axis so it will not interfere with the PLBD's theodolite sightings.

EVENT/CREW TASK

FCS & DED DISPLAY ENTRY CONFIG/BOTH

TIME

TIG -5:52

DISPLAY

N/A

DISCUSSION

The Flight Control System (FCS) and dedicated displays used for atmospheric flight must be configured (turned on) for the FCS checkout and entry. The reconfiguration is performed before configuring the DPS for the on-orbit FCS checkouts (GNC OPS 8 and SM OPS 2) to prevent alarms and fault messages being issued for each piece of equipment not turned on when GNC OPS 8 is loaded. (GNC OPS 8 assumes they should be on.) The equipments reconfigured are the following:

- The RGA's, AA's, and ADTA's are activated through circuit breakers or switches:
 - RGA - four switches turned on
 - AA - two cb's verified close, two switches verified on
 - ADTA - four cb's closed
- The four ASA's are turned on.
- The TACAN's, MLS's, and RA's are activated (TACAN MODE - GPC; MLS and RA-ON). At the same time, the TACAN ANT switches are verified in the AUTO position.
- The right DDU/ADI is powered up (verified by ADI error needles and rate pointers visible). The aft DDU/ADI is turned off (circuit breakers (cb's) - open). The left DDU/ADI should already be on (nominal on-orbit configuration). Control of the DDU/ADI is through cb's only.
- The flight critical dedicated displays and APU/HYD indicators are powered up via the instrumentation power switches.
- The trim panel switch power is turned on.
- The HSI's are verified that their OFF flag is not visible (i.e., the instrumentation power is on).
- The FCS channel switches are verified in AUTO.

The equipment, once it is turned on, is left powered up until postlanding. Turning some of the equipment to OFF after the FCS checkout would possibly invalidate parts of the OPS 8 checkout.

EVENT/CREW TASK

----- DPS CONFIG FOR FCS C/O / PLT -----

TIME

TIG -5:45

DISPLAY

SM 62 PCMMU/PL COMM
GNC 0 GPC MEMORY
GNC FCS/DED DIS C/O
BFS, GNC 0 BFS MEMORY
OR SM THERMAL

DISCUSSION

The DPS configuration consists of three activities:

- TFL for the FCS C/O
- OPS 8 transition
- BFS powerup

Operational instrumentation downlink (telemetry) formats in the PCMMU programable random access memory (RAM) are loaded for the FCS checkout. Using the SM 62 PCMMU/PL COMM display, the fixed 128 kbps format is selected first to provide telemetry while the new formats are being loaded. Formats for the 64 and 128 kbps are then loaded by entering format identification '4' and '162', respectively, and executing 'LOAD'. The programable format is then reselected. The telemetry format load occurs in OPS 2 before the OPS 8 transition.

The 162 format consists of the G8 downlist format 32 in toggle buffer 1 and S2 format 24 in toggle buffer 2.

The DPS is reconfigured for the on-orbit checkout operations after the on-orbit checkout telemetry formats have been loaded. The reconfiguration is accomplished by performing a GNC OPS 801 PRO using a keyboard and CRT that are assigned to the GNC major function. This will cause GPC 1 and 2 to be reloaded with the GNC OPS 8 major function base software from an MMU. The only change to the DPS is to replace the GNC OPS 2 software that was in GPC 1 and 2 with GPC OPS 8 software. The configuration of GPC 3, 4, and 5 remains the same. When the GNC OPS 8 software load has been completed and the major function has been enabled, the OPS display, FCS/DED DISPLAY C/O, will appear on the CRT's assigned to the GNC major function.

The BFS GPC is powered up and moded to STBY to see if it can drive a CRT. This is performed before the OPS 3 transition to allow troubleshooting time in case of a BFS problem.

EVENT/CREW TASK

ON-ORBIT FCS CHECKOUT TESTS/BOTH

TIME

TIG -5:31

DISPLAY

GNC FCS/DED DIS C/O
GNC 0 GPC MEMORY
SM 86 APU/HYD
GNC 40 SENSOR TEST
GNC 41 RGA/ADTA/RCS
GNC 43 CONTROLLERS
GNC 42 SWITCH/SURF
GNC 44 SWITCHES

DISCUSSION

MCC will inform the crew which APU to use (ORR pass).

The on-orbit flight control checkout is performed in two parts with each part consisting of several different tests. The basic difference between the two parts is that the Part 1 testing requires the APU/Hydraulic system to be activated to perform the tests and Part 2 does not. The Part 1 and 2 tests will be performed on entry day.

The on-orbit flight control systems testing is scheduled to ensure STDN coverage during the Part 1 testing and as much of the Part 2 testing as possible. The Part 1 testing requires ground support and monitoring of system parameters not available to the crew during the secondary actuator testing.

The FCS Checkout, Part 1, consists of the tasks listed in the table below.

TABLE 2-I.- ON-ORBIT FCS CHECKOUT, PART 1

Event
FCS C/O PREP
APU PRESTART
FCS CHECKOUT
APU START
INITIATE AEROSURFACE DRIVE
TERMINATE AEROSURFACE DRIVE
SECONDARY ACTUATOR CHECK
APU SHUTDOWN

Before the APU/Hydraulic is activated for the FCS Part 1 testing, the following preparations must be performed:

FCS C/O PREP

The digital event timer (DET) is set-up to count elapsed time during the checkouts. The DET will provide the time reference for performing the Part 1 testing while the APU is activated. A time reference is required in order to not use more than the 5 minutes of APU consumables allocated for the checkouts.

The normal jet drivers are turned on to maintain the tail to sun attitude during the APU thrusting.

APU PRESTART

The APU, HYD, and WB system parameters are checked using the SM 86 APU/HYD display. The '↑' and '↓' indicators are used as cues to indicate out-of-balance rather than checking individual parameters.

- The three boiler controllers and power/heaters are verified in the ON and A positions, respectively, as a precaution against the selected APU system failing. These precautionary steps will allow the crew to quickly switch over to another APU system.
- The A controllers provide the automatic thermal conditioning and H₂O spray boiler operation. The water boilers provide cooling of the lube oil and hydraulic fluid during the APU/HYD operations.
- The hydraulic circulation pumps are verified off, the main pumps are placed in the low pressure mode, and the APU is prepared for activation.

FCS C/O

- Start the DET when MCC gives the GO for APU activation.

APU START

The selected APU fuel tank valve is opened and the APU/HYD READY TO START tb is checked to see if the gray indication is present, indicating that the APU/Hydraulic system has been properly configured for start-up. The gray indication will occur when the following discretes are present.

- HYD main pump press - low
- H₂O boiler controller ready indicator
- APU fuel isolation valves open
- APU gas generator temp > 190° F
- APU turbine speed < 80%

The APU is activated by placing the APU CONTROL 1 (2, 3) switches to START/RUN. The crew then monitors that the hydraulic pressure dedicated meter reads 500 to 1000 psia (low green indicator on meter) and the APU/HYD READY TO START tb becomes barber pole. This confirms that the APU is running at more than 80% speed. When the crew has confirmed that the APU started up normally, the hydraulic main pump pressure switches are placed in the NORM position. The crew then verifies that the hydraulic pressures reads 2900 to 3200 psia (high green indicator). The landing gear hydraulic isolation valves are then placed in the CLOSE position.

Each of the five flight control surfaces (4 elevons, 1 rudder/speedbrake) contain three switching valves (PR, S1, S2). A different hydraulic system will pressurize each of the switching valves which, in turn, will route fluid to its surface actuator. The hydraulic system assignment is found on the APU/HYD display. The crew will verify that the selected hydraulic system is pressurized by checking that an '*' appears beside the hydraulic system number.

INITIATE AEROSURFACE DRIVE

The aerosurface drive is initiated by item entry 10 on the FCS/DED DIS C/O display. Upon receipt of this item entry, the aerosurface drive test (ADT) software initiates a sawtoothed ramp function to drive the aerosurfaces between two points cyclically. The ADT commands the aerosurfaces from their current position to final value 1 at a specified rate for each actuator. (The current aerosurface position was determined when GNC OPS 8 was called by the aerosurface position test software, setting the current, commanded position equal to the mid-value selected position feedback values.) When all commanded positions (not actual) are equal to the final value (FV) 1 values, the actuators are commanded to final value 2. The software pauses at the final value 1 until all commanded values are equal to their desired final value in order to get the elevon position commands together for ease in crew monitoring via the FCS/DED DIS C/O display. After the commanded position for each actuator reaches its final value 2, it is cyclically commanded between the final value 1 and 2 values until a stop aerosurface drive discrete is received. When a stop drive discrete is issued by crew item entry 11, the aerosurfaces are commanded to the final value 3. FV 3 contains the desired actuator positions for entry.

The final values and drive rates for each actuator are as follows:

<u>Actuator</u>	<u>FV 1</u>	<u>FV 2</u>	<u>FV 3</u>	<u>Rate</u>
Elevons	L, R OBU -32.4 ⁰ L, R IBU -32.22 ⁰	17.2 ⁰ 17.3 ⁰	0 ⁰ 0 ⁰	5.8 ⁰ /sec
Rudder	-5 ⁰	+5 ⁰	5.0 ⁰	5.0 ⁰ /sec
Speedbrake	2%	10%	10%	2.7 ⁰ /sec
Body flap	3.5%	93.6%	34.2%	N/A

The aerosurface drive test accomplishes the following three things:

- Warms up the hydraulic loops for performing the secondary actuator test. The heat generated by the main hydraulic pumps and imported to the hydraulic fluid warms the actuators as it passes through them. In order to conserve APU fuel, the surfaces will only be cycled for 5 seconds. If necessary, the circulation pumps may be used.
- Ensures that the GPC can drive aerosurfaces within limits after warmup. If it cannot, the system is either still cold, has a secondary actuator problem, or has a degraded actuator. The secondary actuator bypass function test will detect secondary actuator problems. If the actuator is not being driven within the set tolerance (the difference between actual and commanded position equal to distance driven in 1 second), a status indicator (down arrow) will be displayed next to the affected actuator (FCS/DED DIS C/O display). Initially, when the drive function is first started, all actuators will have down arrows beside them. These down arrows will disappear when the hydraulic fluid warms enough for the actuator to drive at SPEC rates, if everything else is nominal.
- Provides data on the time required to warm up the hydraulics loop using the aerosurface drive cycling function.

TERMINATE AEROSURFACE DRIVE

The aerosurface drive function is terminated by item entry 11 on the FCS/DED DIS C/O display after 5 seconds of aerosurface drive. By this time, the hydraulic system should be warm enough so that no surface position status indicators (down arrows) are present. If a down arrow is still present, that actuator is degraded. The failure is recorded and reported to the ground. The crew will not delay termination of the aerosurface drive function for either a status indicator or for low temperature. The crew enters the SURF DR STOP item number which drives the aerosurfaces to their final entry positions.

SECONDARY ACTUATOR CHECK

The secondary actuator check is the primary check of all the on-orbit checkouts. It provides a means to test for failures of the secondary actuators outside of RM capability and to do something about them. Secondary actuator RM monitors by sensing excessive secondary actuator delta pressure which can result from either or both large rate and position mistracks; that is, if the position or rate of one secondary actuator is different enough from the other secondary actuators, RM will detect a failure and bypass (or isolate) that secondary actuator. Null failures or low rate failures may escape detection by RM and a subsequent channel failure for the same actuator would then result in a two-on-two secondary actuator force fight. The probable results of a two-on-two force fight is the bypassing of the two good secondary actuators, leaving no control of that actuator.

During ascent and the early portion of entry, only small position changes are required. Therefore, RM may not detect a failure until the portion of entry requiring large actuator position changes at fast rates. The secondary actuator tests thus test for these type failures.

There is a positive and negative polarity circuit in the bypass monitor for monitoring secondary actuator delta pressures. The actuator check will be performed twice: once with the positive hardover stimuli and once with the negative (Item 20). Before initiating the secondary actuator tests, the crew will verify that the aerosurfaces are driven to their final entry positions and that the four FCS channels are in the AUTO position. The secondary actuator check will be performed on each FCS channel by first issuing a hardover command. The bypass monitor (which is now enabled) will issue a bypass (tripped) discrete to the secondary actuator channel being tested. If the bypass function occurred, a status indicator (down arrow) will appear alongside each actuator in the column for the channel being tested (on the FCS/DED DIS C/O display), the actuator positions will return to the initial position (no bias), and the ground will observe the secondary actuator delta pressures returning to zero. If all these events occur, the secondary actuators channel tested has no null, position, or rate mistrack failures, and the bypass monitor is functioning for the stimuli polarity used.

After all the ports for the designated channel are verified tripped, the test stimuli is removed. The designated FCS channel is then placed in override to reset the bypass discrete (no '+'). The actuator check for the tested channel is terminated when it is returned to AUTO. The same actuator check process will be performed on each of the four FCS channels. Any failures that occur during this check will be recorded.

After the APU has been deactivated if it is determined by the crew and ground that a secondary actuator is failed, it can be bypassed either by placing the FCS channel switch for the affected channel to OFF, causing all secondary actuators on that string to be bypassed by removing power to the aerosurface servo amplifier (ASA), or by bypassing the individual, failed secondary actuator by the read/write capability on the GPC MEMORY display.

APU SHUTDOWN

After the secondary actuator checks are completed, the APU is deactivated at 04:55 DET. The deactivation consists of turning the boiler controllers and the appropriate APU control off, closing fuel tank valves, shutting off the N₂ supply, and moding to the automatic water spray system. The DFI PCM recorders will also be moded to HI SAMP (10 seconds of data every 5 minutes) since they are only required to record the APU operations.

The On-orbit Flight Control System Checkout, Part 2, consists of the tasks listed in the table below.

TABLE 2-II.- ON-ORBIT FCS CHECKOUT, PART 2

Event
SENSOR TEST - MLS, TAC, RA, AA, RGA, ADTA
RCS DRIVER TEST
FCS MODE/CHANNEL SWITCH TEST
CONTROLLER & SWITCH TEST
DEDICATED DISPLAY CHECK
FLAG TEST
MODE/SEQUENCE LAMP TEST

SENSOR TEST - MLS, TAC, RA, AA, RGA, ADTA

The sensor tests are the first tests to be performed in the On-orbit FCS Checkout, Part 2.

Just before performing the sensor tests, the orbit DAP is switched from A/AUTO/NORM to A/MAN/VERN. The switch to the verniers is to allow damping of the vehicle rates to occur so that the rates will be at a minimum (<0.1⁰/sec) when the rate gyro assemblies and accelerometer assemblies are tested. After the minimum rate is established, free drift is established for the rate gyro accelerator tests by placing the DAP in the pulse mode.

The sensor self-tests are performed using the GNC 40 Sensor Tests and GNC 41 RGA/ADTA/RCS displays. These tests are performed to verify valid sensor outputs and data paths to the GPC's. The microwave landing system (MLS), tactical air navigation (TAC), radar altimeter (RA), and accelerometer assembly (AA) are tested using the SENSOR TEST display. The rate gyro assembly (RGA) and the air data transducer assembly (ADTA) are tested using the RGA/ADTA/RCS display.

The testing of the TAC, MLS, RA, and AA is performed simultaneously by a single item entry. These tests are performed with the Orbiter rates less than 0.1⁰/sec and in a free-drift attitude mode. This is required for testing of the AA and RGA, and will be discussed more fully later. When the tests have been completed, a status indication of BLANK, OFF, or BITE will be displayed for the MLS, TAC, and RA. Data are also displayed for each sensor which is verified to be within the expected limits. If these limits are exceeded, '+' or '-' indicators are displayed. After the crew has verified the health of all the sensors, the test function is terminated by another item entry.

The RAs are also deselected so they will not lock on the nose wheel (problem discovered during the STS-1 flight). The crew will not have autoland capability but can land with three good MSBLS.

To perform the testing of the RGA's and ADTA's, the RGA/ADTA/RCS display is called up. The RGA's and ADTA's will be tested in a HI-test and LOW-test mode by item entry. Both modes are tested to ensure that valid outputs occur over the full range of the sensors. If a status indication of BITE occurs for the ADTA, a memory read is performed. If the last three characters of the data in the ACTUAL column on the GPC MEMORY display is not equal to FDC, FF8, FD8, or FFC, the failed ADTA is deselected. For the RGA's, if the output data do not provide a clear indication of failure and loss of the RGA would make the RGA's single fault tolerant, the RGA could be checked by an attitude maneuver to see if it senses the correct rates.

If the unit is functioning but its response is outside the four sigma limit, there does not appear to be a reasonable method of determining if it is a BITE or an RGA failure. If no output is registered or a 'SMRD' indication appears, we might have either a failed gyro or a failed circuitry. In this case, we could command a 0.5 deg/sec rate and observe whether or not the gyro sees the maneuver. If it does, we have a self test or SMRD circuitry failure and should leave the RGA on. If it does not see the maneuver, the gyro itself has failed and should be deselected.

After either the HI-test or the LOW-test, the test termination item must be entered. If this is not done and the item number for the other test mode is entered or an attempt to call another display is made, an operator error will be displayed.

The testing performed on each sensor is the following:

- MLS -- The self-test takes 6.4 seconds to complete. The MLS's are tested to the hardware design tolerances which are built into the hardware.

Tolerance	0 - 2.0 sec	-	No data change
values:	2.0 - 3.2 sec	-	Range 15.2 ± 2 n.mi., azimuth $30^\circ \pm 0.10$ right of centerline, elevation $60^\circ \pm .10$
	3.2 - 6.4 sec	-	Range 15.2 ± 2 n.mi., azimuth $30^\circ \pm 0.10$ left of centerline, elevation $60^\circ \pm .10$

The self-test tests everything except the transmitter antenna and the coaxial cable leading to the circulator assembly.

- TAC -- The self-test is continuous until the test is ended by the item entry. The TACAN's are tested to the hardware design tolerances which are built into the hardware.

Tolerance values: 0 to 0.5 n.mi.
 $180^\circ \pm 2.5^\circ$ bearing

The self-test tests everything except the transmitter or receiver antennas (upper and lower), antenna switch assembly, duplexer assembly, power amplitude/modulator assembly, portions of the power supply, and the mixer in the receiver assembly. The TACAN unit does not radiate during the self-test.

- RA -- The self-test is continuous until the test is ended by the Item entry. The RA's are tested to the hardware design tolerances which are built into the hardware.

Tolerance value: 1000 ft \pm 100 ft

The self-test tests everything except the receiver antenna-to-mixer signal flow and the plate pulse cavity oscillator-to-transmitter antenna signal flow. The RA unit does not radiate during the self-test.

- AA -- The self-test takes 10 seconds to complete. The AA's are tested to a four sigma tolerance.

Y +14.40 to +17.80
Z +57.70 to +71.10

The self-test tests the entire accelerometer assembly by applying an actual torque. The resulting signals, present acceleration rates, and bias are compared to stored limits to determine pass or fail conditions. An accelerometer bias or shift cannot be detected during the self-test. Since vehicle acceleration rates are summed with the self-test generated signal, the vehicle acceleration rates must be minimized, or the AA could fail the test. To accomplish this, the Orbiter is put in a free-drift attitude mode.

- RGA -- The RGA's are tested to a four sigma tolerance in a HI-test and LOW-test mode.

HI R + 20.0 \pm 1.2
 P + 10.0 \pm 0.6
 Y + 10.0 \pm 0.6

LOW R - 20.0 \pm 1.2
 P - 10.0 \pm 0.6
 Y - 10.0 \pm 0.6

The self-test tests the entire RGA circuitry by applying an actual torque signal. The resulting signals, rates, and bias are compared to stored limits to determine pass or fail conditions. Since the vehicle rates are summed with the self-test generated signal, the vehicle rates must be minimized or the RGA could fail the test. To accomplish this, the vernier thrusters are used to hold attitude. Sufficient time will be allowed for the vehicle rates to damp out and for a free drift mode to be selected before the self-test is performed.

- ADTA -- The ADTA's are tested to limits set to compensate for conversion from binary to decimal in the GPC. The entire ADTA circuitry is checked out during the self-test. Reasonableness test, transducer comparison, memory test data (low and high), and operational data tests are performed. The only test not accomplished is the rate-of-change test.

After the sensors have been tested, the crew records any failed sensors for report to the ground and deselects the failed sensors.

RCS DRIVER TEST

As soon as the RGA and ADTA sensors have been tested, the crew, using the same display (GNC 41 RGA/ADTA/RCS), performs the RCS driver test.

The RCS driver test exercises all circuitry between the GPC's and the RCS solenoids. The three RCS jet groups (forward, aft group A, and aft group B) are tested individually.

The only difference between the self-test and an actual jet firing is the magnitude of the current reaching the solenoids. Driver power is removed from the jets to be tested via D&C panel switches to prevent actual firing of the jets during the test.

For the self-test, the logic power is on, but the driver power is off. Consequently, when the two commands required to fire the jets (CMD A and CMD B) are received from the MDM, only a trickle of current reaches the RCS driver, and this trickle of current is compared in a comparator to a reference value. If the polarity of the comparator signal is acceptable, a BITE output is sent to the GPC's through the MDM, indicating that the RCS driver passed the test.

There are four forward reaction jet driver switches, one vernier driver switch, and four aft reaction jet driver switches. Each contains two sets of self-test circuits. Each set of test circuitry tests six to eight jet drivers, depending on which set it is. All jets in a group are tested regardless of RM status. The test is performed with the vehicle in free drift (orbital DAP in pulse mode, manual control). This action is required because there is presently no interface between the DAP and the RCS; therefore, the DAP has no knowledge that the jets are being tested and that they should not be commanded to fire.

Each jet is sequentially tested by commanding it on (two commands, A and B, are required) and monitoring the BITE. The pass criteria are: jet commanded OFF = LOW BITE discrete; jet commanded ON = HI BITE discrete. If all jets pass, the self-test terminates. The duration of the test from test execution is about 7 seconds. If a jet fails, the test stops and the jet I.D. is displayed. The jet number is recorded and the test is continued by a command given by the crew. After the driver test is completed, the crew will first report any failed jets to the ground before taking any corrective action.

Following the test, the crew will reinitialize the jets counter to zero and deselect any failed jets (if not previously deselected) via the SPEC 23:RCS display. The vernier driver will be moded back on and the vehicle returned to tail to sun.

The self-test will reveal open solenoids, open drivers, and shorted drivers. In addition to the self-testing capability, the RCS will have been tested on the pad and will be continuously monitored by RM during OPS 2 and 8.

Since each self-test circuit is used to test six to eight jets, a failure of the circuit itself would be obvious, because in that event, all jets in the test group would indicate failure. High reliability was cited for the self-test circuitry.

FCS MODE/CHANNEL SWITCH AND CONTROLLER AND SWITCH TESTS

These tests check the outputs (for both commander and pilot) of the FCS CHANNEL and MODE switches; THC, SBTC, RUDDER/BRAKE, BODY FLAP switch; RHC, RHC TRIM switches; and PNL TRIM switches. Some of these are triply redundant contacts and others are doubly redundant. The test verifies transducers and switch contact outputs by exercising controllers/switches and monitoring output on the SWITCH/SURF, SWITCHES, and CONTROLLERS displays. The flight controller power is turned on to power the RHC, THC, and SBTC. Controller switch outputs determined to be failed may only be deselected in strings. Any detected would be a true failure and will be deselected.

DEDICATED DISPLAY CHECK

The dedicated display tests are performed on the Alpha/Mach indicators (AMI), attitude direction indicator (ADI), altitude/vertical velocity indicator (AVVI), horizontal situation indicator (HSI), and surface position indicator (SPI). The test performs basically three functions:

- LOW value test - drives each display to a low value
- HI value test - drives each display to a high value
- FLAG test - drives flags and indicators on each display

The values for the LOW and HI value tests are I-loads and are values which are easy for the crew to monitor. The low values will start with a '2' and the high values will begin with a '3.'

This check exercises the same circuits (MIA, output modules, MDM, and instrument) that are exercised in flight usage. Only the software used to initiate the command is different. During the test, either the forward or aft displays can be selected for checkout. Normally, only the forward displays will be tested for deorbit. This option is selected by an item entry on the FCS/DED DIS C/O display. The crew performs each test (LOW value, HI value, and FLAG) by item entry, and during each test, both the right and left instruments are checked on all four data buses. After all tests have been completed, the last test function is terminated by crew entry of the dedicated display (tests) OFF item number. Any failures are recorded and reported to the ground for determination of their impact on the nominal mission plan.

MODE/SEQUENCE LAMP TEST

The mode/sequence lamp test checks the output of the left and right sequence lights and FCS mode lights. Each light has two bulbs which are powered by one wire. Execution of the MODE/SEQ LT ON item number on the FCS/DED DIS C/O display initiates illumination output to the lamps. Execution of MODE/SEQ LT OFF item number extinguishes output to the lamps. No response is taken by crew other than noting which lamps have failed. (Bulbs cannot be changed.) This test exercises inflight circuitry, although the signals themselves are generated by different (test) software.

EVENT/CREW TASK

RAD BYP/STOW RAD/CDR

TIME

DISPLAY

TIG -4:55

N/A

DISCUSSION

The flash evaporator entry configuration will occur ~50 minutes before PLBD closing (TIG -4:05). This will allow the ground to obtain data on the use of the radiators and as a possible heat sink during entry. If they can serve as a heat sink, they may replace the ammonia boiler system from flash evaporator shutdown until GSE hookup.

Flash evaporator entry configuration consists of enabling the HI LOAD EVAP, resulting in a configuration of both evaporators (HI LOAD and TOP-PING EVAP) providing cooling from payload bay closing to ammonia boiler activation at 120,000 ft. The primary flash evaporator controller A is in the ON position. The HI LOAD EVAP is enabled immediately before radiator deactivation and PLBD closing. The HI LOAD DUCT HTR is required to be on 30 minutes before enabling the HI LOAD evaporator. It was placed in B at TIG -5:35 to warm up the steam ducts. An SM alert may occur because the temperature of hi load duct heater will be around 60-70° rather than the operating range of 300-350°.

The radiators are deactivated immediately following flash evaporator entry configuration and before radiator stowing. Radiator deactivation consists of selecting manual radiator control and placing the bypass valve to the BYPASS position. The radiators are placed in BYP ~50 minutes prior to PLBD closing to allow them to be cold soaked (Freon bypasses the radiators). The radiator controller loops are then turned off.

The water storage system is then configured for entry. This consists of placing the SPLY H₂O XOVR VLV to the OPEN position which enables primary controller A to receive water from tanks C, D, E, and F in addition to tanks A and B. With the valve open, all supply water tanks are interconnected.

The port and starboard radiators will then be stowed and latched. If one of the radiators has trouble with the talkback indication or does not move, the crew will refer to the Malfunction book. If the troubleshooting shows that the tb did not go to bp because of a mechanical jam, the power to the 'bad' radiators (port or starboard) will be removed until the 'good' radiators are stowed and latched. The power to the bad radiator will then be enabled and an EVA performed. If the bad radiators could not be stowed because they were jammed, the good side (port or starboard) will be disabled by removing its power source. The crew will then return the troubled radiators to its initial position and try to restow and latch them.

The power source to stow and latch the radiators is contained in the 'Single Rad Ops' block in the PDP book.

EVENT/CREW TASK

----- DPS ON-ORBIT CONFIG/PLT -----

TIME

TIG -4:54

DISPLAY

SM 62 PCMMU/PL COMM
GNC FCS/DED DIS C/O
GNC 0 GPC MEMORY
GNC UNIV PTG
GNC 23 RCS

DISCUSSION

Operational instrumentation (telemetry) formats in the PCMMU programable random access memory (RAM) are loaded for on-orbit operation before reconfiguring the DPS from the FCS checkout configuration (GNC OPS 8, SM OPS 2) to the on-orbit operations configuration (GNC OPS 2, SM OPS 2). Using the SM 62 PCMMU/PL COMM display, the crew first selects the fixed formats to provide telemetry while the new formats are being loaded. Formats for the 64 and 128 kbps are then loaded by entering format identification '3' and '161', respectively, and executing the LOAD item number. The crew then reselects the programable format.

After the on-orbit operations telemetry formats have been loaded, the DPS is reconfigured for on-orbit operations. The crew accomplishes this reconfiguration by performing an OPS 201 PRO using a keyboard and CRT that are assigned to the GNC major function. This will cause GPC 1 and 2 to be reloaded with the GNC OPS 2 major function base software from an MMU. The only change to the DPS is to replace the GNC OPS 8 software that was loaded in GPC 1 and 2 with the GNC OPS 2 software. The configuration of GPC 3, 4, and 5 remains the same.

EVENT/CREW TASK

TV STOWAGE/PLT

TIME

TIG -4:45

DISPLAY

N/A

DISCUSSION

The crew will verify that the TVs, camera mount and adapters, and auxiliary light were stowed. They were stowed in the Crew Activity Plan (CAP) timeframe.

EVENT/CREW TASK

PRESS CNTL SYS ENTRY CONFIG/CDR

TIME

DISPLAY

TIG -4:21

N/A

DISCUSSION

The two pressure control systems (PCS) will be configured to protect the system/crew in the event of a large cabin leak. Only one PCS is required for on-orbit and deorbit operations. During orbit, the PCS will be configured to maximize the orbit stay time in the event of a large leak. During deorbit/entry, the O₂ supply to the suits is protected.

EVENT/CREW TASK

ARS WATER LOOP 1, 2 ENTRY CONFIG/CDR

TIME

TIG -4:14

DISPLAY

SM 88 APU/ENVIRON THERM

DISCUSSION

Atmosphere revitalization system (ARS) water loop 1 and 2 are configured for one loop operation during entry. This requires a reconfiguration from the nominal on-orbit mode of loop 2 being on and loop 1 operating in a cyclic mode controlled by the GPC. To configure for entry, the H₂O PUMP LOOP 1 switch is configured from the GPC position to the ON position, for 6 minutes. The 6 minute cycling of loop 1 is done to prevent possible freezing when it is deactivated. Loop 1 is then turned off. The loop bypass valves are placed in the manual mode and using the display, the crew verifies that the interchanger flow in both loops are 950 (± 25) lb/min. If required, the flow is adjusted manually by increasing or decreasing the loop bypass valve. The H₂O pump out pressure is then verified that it is 61 - 69 psia.

The water loop 1 and 2 entry configuration is performed in OPS 2 since the display is not available in OPS 3.

EVENT/CREW TASK

IECM CONFIG/CDR

TIME

DISPLAY

TIG -4:07

N/A

DISCUSSION

The induced environment contamination monitor (IECM) is used to obtain data on relative humidity and temperature, dewpoint temperature, trace quantities of various compounds, and airborne particulate concentration in the vicinity of the payload bay.

It is moded to position 2 prior to seat ingress and not more than 1 hour before PLBD closure in order to have the mass spectrometer (MS) turned off and its valve closed. This action will preclude instrument damage.

EVENT/CREW TASK

CONFIG FOR PLBD CLOSING/BOTH

POST CLOSING CONFIG/BOTH

TIME

TIG -4:05
TIG -3:07

DISPLAY

SM 90 OSTA-1 PALLET SYS
SM PL BAY DOORS

DISCUSSION

Prior to PLBD closing, the lights, cameras, monitor, and VTR will be set up. All PLBD operations will be recorded continuously on the VTR. The crew will also setup/activate the theodolite. This is a surveying instrument which will measure the angular distance (azimuth and elevation) between a reference target on the aft bulkhead, a second target on the aft bulkhead, and six pairs of targets along the centerline. It will be mounted in the starboard aft window.

The crew will take theodolite sightings of the starboard and port handrails and port longeron. The port door will then be closed and the port forward and aft bulkhead latched manually. The port door should take 60 seconds (for two motors) to close. Theodolite sightings of the port's centerline latches are then taken.

This is followed by the starboard door alternately started and stopped until it is nearly closed. The crew will determine and record the centerline latch number that will make contact first. The expected contact point will be recorded on the NO GO CRITERIA DIAGRAM. Sightings of the starboard's centerline latches are performed next. The starboard's bulkhead latches are then latched followed by the centerline latches. The last theodolite sightings will be performed on the starboard latches again.

Post Closing Config

The crew will turn off and/or stow the equipments that were only required for the PLBD closing sequence.

EVENT/CREW TASK

RAD HEAT SINK/CDR

TIME

DISPLAY

TIG -3:13
TIG -2:15

N/A

DISCUSSION

This activity along with the RAD BYP actions in the RAD BYP/STOW RAD (TIG -4:55) is performed to obtain data on the thermal capacity of the radiator system. Analysis and ground tests have indicated that the inherent thermal capacity of the radiator system is such that it may be possible to use this capability in lieu of the ammonia boiler system from flash evaporator shutdown until GSE hookup. The data collected from the activities would decide if the system can be simplified and thus save weight.

The crew watches the tb to ensure it does not return to BYP. If it does, the crew will avoid radiator undertemp bypassing (i.e., freezing) by not performing any more steps until MCC is notified.

EVENT/CREW TASK

AUTO MNVR TO TOP TO SUN ATT/CDR

TIME

TIG -3:03
TIG -1:35

DISPLAY

GNC UNIV PTG (OPS 2)

DISCUSSION

As a result of the wing glove thermal stress conditioning problem, the PLBD must be exposed to the sun for two consecutive daylight passes. This action will provide a smaller temperature gradient between the top and bottom of the vehicle.

The first auto maneuver occurs after PLBD closing. The second maneuver occurs after the IMU alignment.

EVENT/CREW TASK

SUIT DONNING/BOTH

SUIT FAN ACT/BOTH

TIME

DISPLAY

TIG -3:00
TIG -2:17

N/A

DISCUSSION

The operational bioinstrumentation system (OBS), G-suit, and the pressure suit (ejection escape suit (EES)) are donned on-orbit before descent. The OBS provides an amplified electrocardiograph analog from the two crewmembers which will be recorded during entry and played back after landing.

If a failure forces the crew to abort during entry, the pressure suit provides environmental protection while the seat ejects the suited crewmembers. It also provides environmental protection from cabin contamination and depressured cabin. Helmets are not donned until seat ingress.

By performing the suit fan activation, suit cooling will be available for aft station operations. The activities consist of the following:

- Connect the vent hose extension to the suit
- Turn on the suit fans
- Adjust the air flow

EVENT/CREW TASK

SNACK/BOTH

TIME

DISPLAY

TIG -2:15

N/A

DISCUSSION

The final crew eating period (snack) will serve mainly as a 'padding' in the case the crew is behind in the timeline. The eating period is constrained to a snack lunch since the food warmer and food trays have already been stowed.

EVENT/CREW TASK

PREL DEORB UPDATE/UPLINK/CDR

TIME

DISPLAY

TIG -2:23

N/A

DISCUSSION

The MCC performs the preliminary uplinks and updates for deorbit. These include the following:

- MCC update of OMS PRPLT PAD/DEL PAD. The crew copies these in the Entry Checklist. If required, an IMU alignment attitude pad will also be updated at this time. An update to the 'second' top to sun attitude (TIG -1:35) will be sent.
- MCC uplinks the prime state vectors and targets.
- For flight 2, the targets cannot be loaded in OPS 2 since the OPS 202 ORBIT MNVR EXEC display will not be supported.

EVENT/CREW TASK

ACT -Z STAR TRK (if BFS omit)/CDR

TIME

TIG -2:02

DISPLAY

GNC DEORB MNVR COAST

DISCUSSION

The crew needs to activate the -Z star tracker (-Y already on) since both are required for the IMU alignment.

EVENT/CREW TASK

HTR CONFIG/PLT

TIME

DISPLAY

TIG -2:00

N/A

DISCUSSION

The fuel cell purge heater is turned on prior to the manual fuel cell purge at TIG -1:21. The purge heater must be on a minimum of 25 minutes before the purge.

Also at this time, the APU HTR TK/FU LINE (six) are placed in AUTO as a backup to the B heaters which are already in AUTO. This is done as a precautionary measure since the switches cannot be reached by the crew after seat ingress. The eight hydraulic heaters are also turned OFF for entry.

EVENT/CREW TASK

HTR CONFIG/PLT

TIME

DISPLAY

TIG -2:00

N/A

DISCUSSION

The fuel cell purge heater is turned on prior to the manual fuel cell purge at TIG -1:21. The purge heater must be on a minimum of 25 minutes before the purge.

Also at this time, the APU HTR TK/FU LINE (six) are placed in AUTO as a backup to the B heaters which are already in AUTO. This is done as a precautionary measure since the switches cannot be reached by the crew after seat ingress. The eight hydraulic heaters are also turned OFF for entry.

EVENT/CREW TASK

AUTO MNVR TO IMU ATT (OMIT IF BFS)/CDR

TIME

TIG -2:00
-

DISPLAY

GNC UNIV PTG

DISCUSSION

The IMU align attitude is the attitude required to place a star in both the -Y and -Z star trackers. The attitude points the -Z axis at the star desired for the -Z star tracker and places the -Y star tracker star as near to the -Y star tracker optical axis as possible. (The angle between the Orbiter -Z axis and the star tracker optical axis is approximately 30°.)

If the BFS is engaged, these actions will be omitted since the BFS does not have the star tracker SOP.

EVENT/CREW TASK

IMU ALIGNMENT (OMIT IF BFS)/CDR

TIME

TIG -1:52

DISPLAY

GNC 22 S TRK/COAS CNTL
GNC 21 IMU ALIGN

DISCUSSION

The IMU's are required to be aligned as close as possible to deorbit to minimize IMU drift errors at EI. If the IMU's are aligned less than 2 hours before EI, it is possible to delay deorbit one orbit and still have acceptable IMU drift at EI. Acceptable platform misalignment per axis at EI is listed below.

900 arc sec - nominal end of mission
2000 arc sec - contingency (e.g., one rev late)

The IMU alignment is considered a critical alignment, requiring that an alignment verification be performed in addition to the alignment.

The alignment, nominally, is performed using two star trackers with manually-selected stars. The initial attitude has already been performed to place the selected stars in the desired star trackers before the alignment is initiated. The crew initiates data collection with the -Z and -Y star tracker item entries on the GNC 22 S TRK/COAS CNTL display. After about 10 seconds, sufficient data will have been collected and the star tracker mode will return to TERM/IDLE. The crew then verifies that S TABLE has good data, proper star ID's, ANG ERR $\leq 0.09^\circ$, and SEL 17 and 18 have '*' beside them. If the above is present, the crew will then verify the item numbers to select the STAR ALIGN mode on all IMU's. The ΔX , ΔY , and ΔZ torquing angles for each IMU are then checked to verify they are $< 0.80^\circ$. If they are $< 0.80^\circ$, the angles and execute time are recorded and the execute item number is entered. If, however, the torquing angles are $> 0.80^\circ$ (which they should not be, since only ~5 hours have elapsed since the last IMU alignment), the crew will maneuver to a new star pair and repeat the alignment. If torquing angles are still too large, they will stop and contact the ground. If, however, they are now acceptable, the alignment is executed and the delta angles are torqued.

After the initial alignment is completed, the Orbiter is manually maneuvered so that a new star pair is present in the star trackers for an alignment verification. The same procedures are performed for the new star pair, except the ΔX , ΔY , and ΔZ torquing angles are verified to be $< 0.1^\circ$. If they are $< 0.1^\circ$, the IMU alignment was good and these delta angles are not torqued.

If the delta angles are greater than 0.1° , they will be torqued out, the vehicle will maneuver back to the previous star pair, and another IMU verification will be performed. The crew will then contact the ground.

If only one star tracker is available or one is determined failed during the alignment, the alignment and alignment verification are performed using one star tracker to take data. This will require two attitudes for each alignment in order to position the two stars in the good star tracker. The rest of the alignment procedures are the same.

EVENT/CREW TASK

FUEL CELL PURGE/PLT

TIME

TIG -1:36

DISPLAY

N/A

DISCUSSION

The fuel cells are manually purged as late as possible before deorbit to raise the voltages for entry. The purge is performed manually since an auto sequence must be initiated 3 hours before reentry to preclude damage to heaters due to reentry heating. Each fuel cell is purged separately for 2 minutes. The crew may use the CRYO/FUEL CELLS display (DISP 68) to monitor the FC O₂ and H₂ flow. Following the purge, the FC purge heater will be moded to GPC for entry.

EVENT/CREW TASK

DEACT STAR TRACKERS & CLOSE DOORS/CDR

TIME

TIG -1:30

DISPLAY

N/A

DISCUSSION

After the entry IMU alignment is completed, the star trackers are deactivated and their doors are closed. The star trackers are deactivated by turning their power off. When the star trackers are turned off, the crew will get an SM alert with a BCE bypass message. They will acknowledge the message to clear the alert and then close the star tracker doors. It takes ~12 seconds for the doors to close nominally. A talkback will indicate 'CL' when the doors are closed.

The star tracker will not normally be used again, but if deorbit is delayed more than one orbit, an IMU alignment will be required before deorbit can occur, and 15 minutes must be allowed for star tracker warmup before the alignment.

EVENT/CREW TASK

PRE INGRESS CONFIG/PLT

TIME

DISPLAY

TIG -1:28

N/A

DISCUSSION

MPS REPRESS PREP

Preparation for the main propulsion system (MPS) repress is performed before seat ingress for crew accessibility to control panel R2 and R4 and before actual MPS feedline pressurization with helium during entry (h = 225,000 ft). The prep includes all necessary activity for the pressurization. The actual repress is delayed as late as possible during entry to avoid depletion through leakage of the helium pressurant gas but above 200,000 ft to prevent contamination or corrosion of the MPS. Repressurization of the main propulsion system with helium during atmospheric entry prevents contaminants from entering the MPS Orbiter lines and SSME's. If the MPS are contaminated, cleanliness test would be required and affected components may have to be removed for cleaning. This could increase Orbiter turnaround time between flights.

The crew will perform contingency steps to close the prevalves if the ground determines that at most 74 pounds of helium is left. The helium in the manifolds will be isolated to prevent it from being vented overboard.

MLS CH/TACAN CH

The manual TACAN channels are configured to channel 111 for the nominal end-of-mission deorbit. This is performed before seat ingress since these switches are difficult to reach and read after seat ingress.

BRAKE/ANTISKID ACT

The antiskid portion of each brake/skid control circuit is powered ON. The brake system is powered up by placing the brake MNA, MNB, and MNC power switches to the ON positions. Three switches provide redundant main bus power to brake buses CA and BC. Brake bus CA provides power to brake/skid control box A and brake bus BC provides power to brake/skid control box B. When the brake power switches are turned ON, the brake portion of each brake/skid control circuit is immediately powered, and braking is enabled.

The brake system is powered up before seat ingress since the switches are located on panels 014, 015, and 016.

SSME HYD REPRESS PREP

The preparation for SSME repositioning is performed before seat ingress for crew accessibility to controls (panel 017) and before engine repositioning, which occurs after APU activation. The preparation includes placing the four FCS channels to AUTO and the four ascent thrust vector controls to ON. The MEC switches are turned on before turning on the ATVC's to preclude a possible short problem.

RESET C/W

The OMS fuel and oxidizer C/W pressure limits are changed to the higher BFS limits (288 psi - BFS, 284 - PASS) to allow more leeway before an alarm is sounded.

The hydraulic systems caution and warning parameters for low hydraulic pressure are activated in order that an alarm will be sounded when the hydraulic pressure drops below 2760 psia during deorbit to landing. These parameters are enabled prior to the crew ingressing their seats, since the C/W panel is in the aft station (panel R13). When they are enabled, an alarm will be sounded and the HYD PRESS C/W and MASTER ALARM lights will be illuminated. These alarms and lights were activated since the hydraulic system is still deactivated. The master alarm is reset, but the HYD PRESS C/W will remain lit until the hydraulic systems are activated and brought up to operating pressures.

DFI/ACIP HTR

The PCM PRESS XDCRS are switched to AUTO, the DFI wideband mission power is verified on, the ACIP HTR is moded off, and the OEX power is turned on for entry. These must be configured before seat ingress since the switches are located on panel R11.

ENTRY COMM CONFIG (FLT DECK)/TELEPRINTER DEACT

Prior to seat ingress, the comm is configured for entry. For redundancy management the two AUD A/G switches are placed to transmit/receive. This enables the S-band and/or UHF comm to the crew.

The teleprinter is deactivated by turning off its power sources and verifying that its locker door is secured.

EVENT/CREW TASK

CONFIG RJDs/HTRS/CDR

TIME

TIG -1:24

DISPLAY

N/A

DISCUSSION

The crew will ensure that the normal drivers are on since OPS 3 (TRANS DAP) only fires normal jets. The vernier driver will be turned off.

Heaters are turned off since they are not accessible after seat ingress if they fail or overheat.

EVENT/CREW ACTION

DPS ENTRY CONFIG/PLT

TIME

DISPLAY

TIG -1:22

GNC UNIV PTG
GNC 0 GPC MEMORY
BFS, GNC 0 BFS MEMORY
SM 0 GPC MEMORY
SM 62 PCMMU/PL COMM

SM 60 SM TABLE MAINT
SM 1 DPS UTILITY
GNC DEORB MNVR COAST
BFS, GNC DEORB MNVR COAST

DISCUSSION

The DPS entry configuration consists of transitioning from the deorbit prep on-orbit configuration (GNC and SM OPS 2) to the entry configuration (GNC OPS 3 and BFS) shown below.

TABLE 2-III.- DPS CONFIGURATION

Configuration	GPC				
	1	2	3	4	5
On-orbit configuration					
Major function (OPS)	GNC 2	GNC 2	GNC 3 ^a	SM 2	BFS, OPS 0
Mode switch	RUN	RUN	HALT	RUN	STBY
Output switch	Normal	Normal	Normal	Terminate	Normal
String assignment	1, 4	2, 3	--	--	--
CRT assignment	1	2, 4	--	--	--
Entry configuration					
Major function (OPS)	GNC 3	GNC 3	GNC 3	GNC 3	BFS, GNC 3
Mode switch	RUN	RUN	RUN	RUN	RUN
Output switch	Normal	Normal	Normal	Normal	Backup
String assignment	1	2	3	4	--
CRT assignment	1	2	3	--	--

^aFreeze-dried.

The transition to OPS 3 is performed in three parts. In Part 1, a two-GPC redundant set is transitioned to GNC OPS 3 using an MMU as a source. The freeze-dried GPC remains in STBY, and GPC 4 remains in SM OPS 2. In Part 2, the BFS GPC 5 is transitioned to OPS 3. In Part 3, GPC 3 and GPC 4 are added to the GNC OPS 3 redundant set. By accomplishing the reconfiguration in three steps, one GPC with the OPS 3 overlay intact is guaranteed (GPC 3), thus eliminating the possibility of a loss of flight control capability and a moving of the PASS GPC's to OPS 0, should a transition failure occur.

Additional activities integrated into the DPS entry configuration include:

- LAND SITE UPDATE
- CRT's/UPLK RECONFIGURATION
- ENTRY TFL LOAD
- SM2 CHECKPOINT/UL CNTL ENA
- BFS TFL ENABLE
- PLBD OPS CRT's RECONFIGURATION
- POST LANDING SETUP
- MEMORY DUMP SETUP

Step 1 - LAND SITE UPDATE

A landing site update is required if the nominal landing site is not desired. This update must be performed in the PASS before the transition to OPS 3 because the UNIV PTG display, which is used to update the landing sites, is only available in GNC OPS 2.

The nominal primary, secondary, and alternate landing sites are OPS 2 I-loaded data and are:

ITEM 25	PRI	<u>19</u>	EDW 23
ITEM 26	SEC	<u>20</u>	Northrup 17
ITEM 27	ALT	<u>21</u>	EDW 17

The landing sites loaded into these slots are carried across the GNC OPS 3 transition and are displayed on the HORIZ SIT display. The crew will change the alternate landing site to EDW 15 since this runway will be drier if it rains.

The 10 TACAN's and 2 MSBLS's associated with the three runways are also carried across the transition.

If the nominal end-of-mission landing sites (values 19, 20, and 21) are changed (e.g., 1 to 18 input) and it is later desired to reselect the nominal end-of-mission, an illegal entry will result if values 19, 20, and 21 are selected via items 25, 26, and 27 on the UNIV display. To reselect values 19, 20, and 21, an OPS MODE recall (OPS 201 PRO) is required.

If landing sites are changed, the landing site update must also be done in the BFS (GNC 51 OVERRIDE, items 6 to 8). This action, if required, will be performed in the ENT C/L.

Step 2 - VERIFY CONFIG/PWR UP GPC 3

The five GPC power, output, and mode switches are verified and or powered before GNC OPS 3 transition. The GNC OPS 3 transition is based upon starting in this configuration and that all five GPC's are functioning properly.

Step 3 - RECONFIG CRTs/UPLK

Before transitioning GPC 1 and GPC 2 to GNC OPS 3 (using MMU as OPS 3 source) the following activities are performed.

- Inhibit the GPC from accessing the command words from the NSP.
- Turn on the power to CRT 3.
- Assign CRT 3 to the SM GPC (GPC 4).

Step 4 - Transition GPC 1 & 2 to GNC OPS 3 (DPS Config - Part 1)

Memory configuration 3 (GNC OPS 3) is modified to have GPC 1 and GPC 2. Strings 1 and 4 are assigned to GPC 1; strings 2 and 3 to GPC 2. CRT 1 is assigned to GPC 1; CRT 2 and 3 to GPC 2. String assignments are made so that the NSP's are driven by different GPC's. GPC 1 and GPC 2 are then transitioned to OPS 3.

The configuration at this point is:

GPC	1	2	3	4	5
OPS	GNC 3	GNC 3	GNC 3 (freeze-dried)	SM 2	BFS, OPS 3
Mode	Run	Run	STBY	Run	STBY
Output	Normal	Normal	Normal	Terminate	Normal

Step 5 - LOAD ENTRY TFL

After GPC's 1 and 2 are transitioned to OPS 3, the PCMMU format is changed to 5 (low data rate format) and 164 (high data rate format). The format must be changed in SM OPS 2 since this PCMMU/PL COMM display is not available in OPS 3.

Step 6 - SM2 CHECKPOINT/UL CNTL ENA

Before transitioning GPC 4 (containing SM OPS 2) to GNC OPS 3, an SM checkpoint is performed on both MMU 1 and MMU 2. The SM checkpoint is performed in case deorbit is delayed (e.g., 24-hr delay) and/or a transition back to SM OPS 2 is required. The data in this checkpoint includes current Fault Detection and Annunciation (FDA) status, including limit values, noise filter constants, telemetry constants, parameter annunciation inhibits, and current time. This eliminates having to uplink any changes that were previously made to these parameters since the initialization of SM 2 during post insertion.

The checkpoint is initiated by an 'ITEM 18 EXEC' input to the SM TABLE MAINT display. If the checkpoint is successfully written, the time and status (GOOD) will appear.

The checkpoint retrieve function on the DPS UTILITY display is enabled so that the checkpoint data will be incorporated when the SM 2 transition occurs (e.g., 24-hour delay deorbit).

The manual uplink control will also be enabled.

Step 7 - Transition BFS GPC to GNC OPS 3 (DPS Config - Part 2)

- The BFS GPC is allowed to communicate with CRT 3 preengaged.
- Its output is placed in BACKUP to allow BFS engage capability. GPC 5 can now command CRT's 1 and 3.
- On the BFS MEMORY display, the crew will verify that the TFL is enabled. This action will load and verify the PCMMU whenever a PCMMU switchover occurs.
- The BFS GPC will be transitioned to OPS 3.

Step 8 - Transition GPC 1,2,3,4 to GNC OPS 3 (DPS Config - Part 3)

Before adding GPC 3 and GPC 4 to the GNC OPS 3 redundant set, the following activities occur:

- The payload buses are released by SM (GPC 4) by moding the SM to OPS 0. The BFS will have control of the payload buses when it goes to RUN.
- GPC 4 output is placed in 'NORMAL' allowing communication with flight critical buses.
- GPC 3 is moded to RUN. At this point, it will be processing OPS 0 software only and retaining GNC OPS 3 in main memory.
- GPC 5 is moded to RUN. It picks up the payload buses, and is running in BFS OPS 3.
- Memory configuration 3 (GNC OPS 3) is modified to include GPC's 1, 2, 3, and 4. Strings 1, 2, 3, and 4 are assigned to GPC's 1, 2, 3, and 4, respectively. CRT's 1, 2, and 3 are assigned to GPC's 1, 2, and 3, respectively. String assignments are divided among the GPC's to reduce the impact of a GPC failure.

GPC's 3 and 4 are then added to the GNC 3 redundant set by a GNC 'OPS 301 PRO.' The source of the GNC major function base is GPC 1 which is the lowest number GPC with the GNC major function base. All other GPC's retain the OPS 3 overlay which is already resident in their memories. An I/O RESET EXEC is then executed on the BFS (GPC 5) to ensure that it continues to track the PASS after the PASS strings are reassigned.

Step 9 - Load in TGTs

The crew will load the deorbit targets (uplinked at TIG -2:23:PREL DEORB UPDATE/UPLINK) and start the CRT timer. They will then compare the onboard deorbit target solution to the burn attitude, apogee, perigee, Δ VTOT, and TGO on the DEL PAD.

Step 10 - RECONFIG MC 9 TABLE (GNC 9) for POST LANDING

The pilot will reconfigure the memory configuration table for post landing. All four GNC GPCs are assigned to GNC 9 since KSC wants a redundant set for engine bell movements.

Certain capabilities are reduced or lost once GNC OPS 3 is obtained. These restrictions are summarized below:

Category	Constraint
DAP	TRANS DAP o DISC rate 0.5 ^o /sec (manual mode) o Dead band 3.5 ^o o Higher RCS usages o No vernier control
Landing site	To change the PASS, must return to OPS 2. BFS must be changed in GNC OPS 3.
Vent doors	Ground cannot command individual doors in GNC OPS 3.
SM	No SM except for BFS; reduced FDA.
PCMMU TFL	If a PCMMU switchover occurs, must use fixed format. (TFL restricted to OPS 2.)
Port moding	Limited to OPS 2.
RGA	A minimum of two RGA must be on to retain attitude control in GNC OPS 3.
Time	Crew cannot change CRT timer in GNC OPS 3.

EVENT/CREW TASK

REWIND PCM RCDR/CDR

TIME

DISPLAY

TIG -1:20

N/A

DISCUSSION

In order to ensure there would be enough tape to record the whole mission, the PCM recorder had to be managed. The first three tracks of tape (~96 minutes at continuous record) were saved for entry data. The first three tracks were saved as a precaution against data loss before the scheduled rewind. If the power were removed, the recorder would reset to the beginning of track 1.

EVENT/CREW TASK

CLOSE ALL VENTS EXCEPT LEFT 1,2,8,9/PLT

TIME

TIG -1:11

DISPLAY

GNC 51 OVERRIDE

DISCUSSION

In order to protect against thermal damage and pressure vessel leaks which could overpressurize the vehicle if the vent doors were shut, all the vent doors except 1,2,8,9 will be closed. Leaving vents 1,2,8, and 9 would cause the least damage if they were left open to overvent leaks.

EVENT/CREW TASK

SEAT INGRESS/BOTH

TIME

TIG -1:00

DISPLAY

N/A

DISCUSSION

The activities associated with seat ingress and helmet donning occur before the maneuver to the deorbit burn attitude and OMS burn prep. Before ingressing the seat, the crew removes covers from the drogue gun, disconnects and stows the vent hose extension, and stows the comm equipment. The crew then ingresses the seat and connects the vent hose, attaches the foot spurs, and connects the biomed cable.

The crew then dons his helmet, connects O₂ leads, and closes the visor to perform a comm check and O₂ suit pressure integrity check. The visor is then placed in the up position.

2.3 D/O PREP BACKOUT PROCEDURE DETAILS

The following pages contain detailed discussions of the Deorbit Prep Backout Procedures.

EVENT/CREW TASK

SEAT EGRESS/BOTH

CONFIG COMM/DFI/BOTH

TIME

5/3:23 MET
5/3:34 MET

DISPLAY

N/A

DISCUSSION

After the crew receives a NO-GO for the deorbit burn (TIG -20) and gets a GO for the 24-HR EXTENSION, the crew performs the PDP's D/O PREP BACKOUT procedure. The crew begins with seat egressing. This task consists of several interrelated tasks beginning with removing and temporarily stowing their gloves. The lap belt, shoulder harness, hoses, and cables are disconnected, and the helmets are doffed. When all of the man/seat interfaces have been disconnected, both crewmembers egress their seats, unstow the vent hose extensions, and connect them to their suits and seats for cooling while working in the aft station. At the aft station, the crew dons the on-orbit communication equipment (they had stowed their headset in their suit pocket during suit doffing). Their headsets are connected to the communication outlets on panels A11 and A15.

The DFI PCM PRESS XDCR's are changed from AUTO to OFF (on-orbit configuration).

EVENT/CREW TASK

VERNIER HTR ACT/PLT

AUTO MNVR TO -ZLV (Y-POP, NOSE FWD), CDR

CONFIG RJDs/BOTH

TIME

5/3:39 MET
5/4:06 MET
5/4:41 MET

DISPLAY

GNC UNIV PTG

DISCUSSION

Since the vernier jets are not used in OPS 3, they were deactivated prior to the OPS 3 transition (TIG-1:22) in the D/O Prep section. These jets are used on on-orbit so they must be warmed up.

The time period required to warm up the vernier jets is directly proportional to the amount of time they were deactivated. As a result, the crew will not use these jets until they receive a GO from MCC.

The crew will maneuver back to their on-orbit -ZLV (Y-POP) attitude with the normal jets. By 5/4:41, the vernier jets should be ready to use. The crew will reconfigure from the normal jets to the verniers.

EVENT/CREW TASK

OPEN VENT DOORS/CDR

TIME

5/3:40 MET

DISPLAY

GNC 51 OVERRIDE

DISCUSSION

The crew will reopen all the vent doors (normal on-orbit configuration). All the vent doors except 1, 2, 8, and 9 were closed during the deorbit prep timeframe.

EVENT/CREW TASK

RAD ACT/CDR

TIME

5/3:42 MET

DISPLAY

N/A

DISCUSSION

The radiators are activated before PLBD opening. The RAD CONTROLLER OUT TEMP switch is verified in the NORM position, the BYPASS VALVE MODE switches 1 and 2 are placed in AUTO, and the RAD CONTROLLER LOOP 1 and 2 switches are placed in AUTO A. This causes the radiators, after approximately 90 seconds, to go from a manually-set full bypass to an automatically-controlled mode which bypasses enough Freon flow to maintain the radiator outlet temperatures within normal limits. This is indicated by the BYP VLV tb changing from BYP to RAD indicating radiator flow.

The RAD CONTROLLER OUT TEMP switch in the NORM position causes the controller to control temperature out of the radiator at 38° F.

The radiators are activated before PLBD opening to prevent an initial surge of cold Freon in the radiator from possibly automatically shutting down the controller if flow were started after the PLBD's are opened.

At the end of the radiator activation procedure, H₂O pump loop 1 is placed in the GPC position. This is scheduled to occur before the transition to SM OPS 2 so that the pump will cycle on at the SM 2 transition. Since the loop 1 was deactivated during the deorbit prep, the loop needs cycling to prevent possible freezing. If the switch is placed in the GPC position after the transition, the time that the pump will come on depends upon where the timer is in its cycle.

EVENT/CREW TASK

CONFIG FOR PLBD OPENING/BOTH

TIME

5/3:45 MET

DISPLAY

BFS, SM 63 PL BAY DOORS

DISCUSSION

All the PLBD operations will be recorded continuously on the VTR.

The PLBD's are opened using the BFS software, with the pilot carrying out the procedures and the commander monitoring the door opening through one of the payload bay windows. The pilot performs the procedure from the mission specialist station using CRT 4 with the SM 63 PL BAY DOORS display. The pilot turns on ac power to the door and latch motors and selects the manual opening mode with item entries on the PL BAY DOORS display. This mode was selected since possible DPS failure modes have been identified which could cause out-of-sequence payload bay door latch and door drive commands which could, in turn, lead to structural door damage. It also allows the crew to monitor latch status and assures that door operations do not proceed if out-of-sequence failures occur. For emergency situations, auto operation is permissible.

The pilot will set a timer to time the opening duration partly to fulfill an FTO (to record the times from activation of the latch position until latch open indications are received on the CRT) and partly as a means of verifying that each step of the opening sequence occurred as scheduled.

Before initiating the door opening sequence, the PL BAY DOOR switch on panel R13 is verified in the STOP position. The crew will then open the center latches (5-8, 9-12, 1-4, 13-16) and the starboard and port forward and aft latches and doors. They should also verify that the status OP/CL indicators on the display indicates OP after each operation. If the pilot or commander notices an anomaly in the opening sequence and wants to stop the opening sequence, the switch can be returned to the STOP position, and the opening sequence will stop at that point. The door opening sequence takes approximately 3 minutes and 46 seconds, normally, but it could take longer if one of the two motors on a latch group or door has failed. After the doors are verified open and the PL BAY DOOR switch is placed in the STOP position, the pilot can then turn off the ac power.

EVENT/CREW TASK

RAD DEPLOYMENT/BOTH

TIME

5/3:53 MET

DISPLAY

N/A

DISCUSSION

The radiators are deployed immediately after the PLBD's have been opened. The pilot prepares for the deployment by enabling power for the radiator latch and deployment motors. This is done by setting the PL BAY MECH PWR switches to ON. The latch release and radiator deployment times will be recorded to fulfill an FTO requirement and will be used to monitor whether one of the two motors driving the latches or radiators has failed.

The pilot first releases the starboard and port latches by setting the STBD and PORT LATCH CONTROL switches to RELEASE. The elapsed time between release and when the STBD and PORT LATCH tb indicates REL is recorded. The STBD and PORT LATCH CONTROL switches are then placed in OFF, and the timer is reset. The pilot then deploys the starboard and port radiators, while timing the deployment duration, by setting the STBD and PORT RADIATOR CONTROL switches to DEPLOY. When the tb indicates DPY, the crew will start the timer. It will be stopped after the tb indicates REL. Both RAD CNTL SYS switches will then be placed in OFF. When both radiators have been deployed, the PL BAY MECH PWR switch is set to OFF, removing power from the motor Remote Power Controllers (RPC's).

Latch release and radiator deployment times for one motor are 25 seconds and 40 seconds, respectively.

EVENT/CREW TASK

DPS CONFIG TO GNC 2/SM 2 / PLT

TIME

DISPLAY

5/3:55 MET

GNC 0 GPC MEMORY	SM 1 DPS UTILITY
GNC UNIV PTG	SM 62 PCMMU/PL COMM
BFS, GNC 0 GPC MEMORY	SM 0 GPC MEMORY
PL 0 GPC MEMORY	SM SYS SUMM 1
SM ANTENNA	

DISCUSSION

After the PLBD's are opened and the radiators are deployed, the Orbiter can safely stay on-orbit for another 24 hours. At this time, the DPS configuration to OPS 2 is performed.

- First, the memory configuration 2 is modified to contain GPC 1 and 2. Strings 1 and 4 are assigned to GPC 1. Strings 2 and 3 are assigned to GPC 2. String assignments are made to distribute the NSP's among the GPC's for redundancy. CRT 1 is assigned to GPC 1. CRT's 2 and 3 are assigned to GPC 2.
- After the OPS 2 two-GPC redundant set is created, GPC 3 will be freeze-dried with OPS 3 to provide an OPS 3 source in addition to the MMU. The major function switch is placed in a nonexisting major function (PL) to assign CRT X to GPC 3. The GPC MEMORY display is then displayed on CRT X, and memory configuration 3 is modified to contain GPC 3 and strings 1, 2, 3, and 4. GPC 3 will be moded to STBY (freeze-dries OPS 3 in main memory) after the SM OPS 2 GPC is added to the common set and the GPC/LDB option is selected. This option allows the MMU repositioning to be bypassed.
- Next, the SM GPC will be added to the common set. First, GPC 5 is moded to STANDBY to release the payload buses. GPC 4 output is placed in TERMINATE to protect the SM computer from inadvertently communicating with the flight critical strings. GPC 5 output is then placed in NORM to disable its BFS engage capability. With the major function switch in PL (nonexisting major function), CRT X can be assigned to GPC 4. Memory configuration 4 (SM 2) is then modified to contain GPC 4, and CRT 1, 2, and 3 are assigned to GPC 4. GPC 4 is then transitioned to SM OPS 201.

- Operational instrumentation (telemetry) formats in the PCMMU programmable Random Access Memory (RAM) are loaded for on-orbit operation after the DPS is transitioned from the entry configuration (GNC OPS 3, BFS) to the on-orbit configuration (GNC OPS 2, SM OPS 2).

The TFL is done with the SM 62 PCMMU/PL COMM display. The crew first selects the fixed formats by item entry to provide telemetry while the new formats are being loaded. The new formats for the 64 and 128 kbps are then loaded by entering (via item entries) format identification 3 and 161, respectively, and executing the LOAD item number. The crew then reselects the programmable format by item entry.

- The CRT's will be placed in their on-orbit configuration (CRT's 1, 2, and 4 ON, CRT 3 OFF). Since the mission is to extend for another 24 hours, the power level needs to be reduced. As a result, CRT 4 will also be turned off. It can be turned on if required.
- The pilot will reset the I/O ERROR LOG, extinguish the CAM lights, and restart the sync history.

EVENT/CREW TASK

RAD VERIF & FLASH EVAP CONFIG/CDR

TIME

5/4:00 MET

DISPLAY

SM 88 APU/ENVIRON THERM
SM SYS SUMM 1

DISCUSSION

The flash evaporators are moded to the on-orbit configuration after the radiators are deployed and after transitioning back to SM OPS 2. When the radiators are not activated, both the topping and high load flash evaporators are required to provide enough cooling for the Orbiter equipment. After the radiators are activated, the high load evaporator is turned off. Before turning the high load evaporator to OFF, the crew confirms that the FREON LOOP RAD OUT TEMPS are in their normal operating range (<60° F) ~15 minutes after the radiators are deployed. This is verified via the SM 88 APU/ENVIRON THERM display. The FLASH EVAP CONTROLLER PRI A remains in the ON position for on-orbit operations. The supply H₂O crossover valve will also be moded to its on-orbit configuration (CL).

EVENT/CREW TASK

BRAKES, MPS, FCS & DED DISP ON-ORBIT CONFIG/BOTH

TIME

DISPLAY

5/4:05 MET

N/A

DISCUSSION

Since the FCS and dedicated displays were configured for entry, they must be configured back to the on-orbit configuration.

The equipments reconfigured are:

- The brakes and RGA's are turned off.
- The ADTA's are deactivated by opening the circuit breakers.
- The forward right DDU/ADI are powered down; the aft DDU/ADI are powered on. Normal on-orbit ADI configuration is one forward and one aft ADI.
- The ASA's for the aerosurfaces are turned off.
- The ATVC's and MEC's, which were used in SSME HYD REPRESS PREP, are placed to off. Note that the MEC's should be placed in OFF after the ATVC's are turned off to prevent a possible short.
- The TACAN's, RA's, MLS's, and ANTISKID are turned off.
- The MPS system, which was configured for repress during entry, is placed in the on-orbit configuration.
- The flight controller power switches are placed to OFF. This action deactivates the RHC's, THC, and SBTC's. The trim panel and instrumentation power are turned off.

EVENT/CREW TASK

SUIT DOFFING/BOTH

TELEPRINTER ACTIVATION/PLT

FDF/DOSIMETER CONFIG/PLT

TIME

DISPLAY

5/4:13 MET
5/4:27 MET
5/4:35 MET

N/A

DISCUSSION

The crew doffs the Ejection Escape Suit (EES), Operational Biomed System (OBS), and G-suit after the auto maneuver. The crew dons intravehicular activity (IVA) clothing, prepares the OBS for the next donning, and stows the EES, OBS, and G-suit in the appropriate locations. The helmets and gloves doffed earlier are also stowed at this time.

The teleprinter, which was deactivated earlier (-TIG -1:13), is activated again for on-orbit messages.

The crew unstows the necessary Flight Data File (FDF) and radiation instrumentation from the stowage lockers. Since the entry FDF articles are no longer required, they are stowed in lockers R5 and C6 until required again.

EVENT/CREW TASK

CONFIG CABIN TEMP CNTL/PLT

PRESSURE CONTROL SYS ON-ORBIT CONFIG/CDR

TIME

5/4:32 MET
5/4:35 MET

DISPLAY

N/A

DISCUSSION

The cabin temperature control and PCS will be configured back to its nominal orbit configuration. PCS system 2 will be left OP (System 1 CL) since only one PCS is required for on-orbit operations.

EVENT/CREW TASK

STAR TRACKER ACT/CDR

TIME

5/4:39 MET

DISPLAY

GNC 22 S TRK/COAS CNTL

DISCUSSION

The star trackers are powered back up and their doors are opened. These actions will put them back in their normal on-orbit operations configuration.

The star trackers are turned to ON with the STAR TRACKER POWER -Y and -Z switches (panel 06). A GNC I/O reset is then performed to get the GPC's to recognize that the star trackers are turned on and should be interrogated by them. If any IMU, ADTA, MLS, STU, MTU, or RR is off when the strings are recharged with the I/O reset, an SM alert (BCE BYPASS) message will be generated. The star tracker doors are then opened. The normal opening time for each door is less than 12 seconds; but if one motor is failed, it could take 2 minutes. Both -Y and -Z STAR TRACKER POWER switches must be on in order to open the star tracker doors. The -Z star tracker is then powered to OFF, the normal on-orbit configuration. The star trackers require a 15 minute warmup before they can be used for taking data for an IMU alignment.

EVENT/CREW TASK

HYD C/W & IECM ON-ORBIT CONFIG/CDR

TIME

5/4:50 MET

DISPLAY

N/A

DISCUSSION

The OMS fuel and oxidizer C/W pressure limits are reset to the PASS limit (284 psi) from the BFS limit (288 psi).

The hydraulic systems caution and warning parameters for low hydraulic pressure were enabled for entry. These parameters are inhibited for on-orbit operations since the hydraulic parameters are only required when the hydraulics system is operating. When they are inhibited, the HYD PRESS light on the panel F7 C/W matrix will go out. If the parameter were not inhibited, an alarm would be sounded every time the pump was turned back off.

The induced environmental contamination monitor (IECM) is placed in POS 1 after the PLBD opening to turn the mass spectrometer on. This is done after the opening to ensure that the partial pressure in the payload bay is low enough.

EVENT/CREW TASK

MIDDECK CONFIG/PLT

TIME

DISPLAY

5/4:54 MET

N/A

DISCUSSION

The middeck configuration consists of reconfiguring the following various crew systems equipment to the nominal on-orbit condition.

- The WCS vacuum valve is opened and the foot restraint is positioned down and locked.
- The personal hygiene kits, mirrors, wipe dispensers, etc., are unstowed and installed. The crew at the same time activates the water dispenser.

EVENT/CREW TASK

ON-ORBIT HTR CONFIG/CDR

TIME

5/5:00 MET

DISPLAY

N/A

DISCUSSION

The on-orbit HTR CONFIG consists of reconfiguring the following heaters to the nominal on-orbit state.

- The BOILER CNTLR, which controls the APU steam vent heaters, is turned to OFF.
- The HI LOAD DUCT HTR is turned to OFF. This occurs no earlier than 30 minutes after the HI LOAD EVAPORATOR is turned to OFF to preclude possible freezing.
- The APU HTR TK/FU LINE B is turned to OFF. A heaters remain in AUTO.
- All HYD B heaters are placed in AUTO. The A heaters are verified in OFF.
- RCS/OMS FWD POD and OMS CRSFD LINES B heaters are placed in AUTO while the A heaters are in OFF.
- The WASTE H2O VAC VENT NOZ HTR is turned to ON, the ISOL VLV CNTL to OP.

APPENDIX

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AA	Accelerometer Assembly
ADI	Attitude Direction Indicator
ADTA	Air Data Transducer Assembly
AFD	Aft Flight Deck
AMI	Alpha/Mach Indicator
ANG	Angle
AOA	Abort Once Around
AOS	Acquisition of Signal
APU	Auxiliary Power Unit
ARS	Air Revitalization System
ASA	Aerosurface Amplifier
ATCS	Active Thermal Control Subsystem
AVVI	Altitude/Vertical Velocity Indicator
BDA	Bermuda
BFS	Backup Flight System
CAL	Calibration
CAP	Crew Activity Plan
CCTV	Closed Circuit Television
CLS	Contingency Landing Site
C/O	Checkout
COAS	Crew Optical Alignment Sight
C/W	Caution & Warning
DAP	Digital Auto Pilot
D&C	Displays & Controls
DED	Dedicated
DET	Digital Event Timer
DEU	Display Electronics Unit
DFI	Development Flight Instrumentation
DISP	Display
DPS	Data Processing System
ECLSS	Environmental Control & Life Support System
EES	Emergency Escape Suit
EET	Entry Elapsed Time
EI	Entry Interface
ERR	Error
EVA	Extravehicular Activity
FC	Fuel Cell
FCS	Flight Control System
FDA	Fault Detection & Annunciation
FDF	Flight Data File
FES	Flash Evaporator System
FOV	Field-of-View
FTO	Flight Test Objective

GDS	Goldstone
GNC	Guidance, Navigation, and Control
GWM	Guam
HDR	High Data Rate
HSI	Horizontal Situation Indicator
HYD	Hydraulic
IECM	Induced Environmental Contamination Monitor
IMU	Inertial Measurement Unit
IOS	Indian Ocean Station
LDR	Low Data Rate
LOS	Loss of Signal
MCA	Motor Control Assembly
MCC	Mission Control Center
MDM	Multiplexer/Demultiplexer
MEC	Master Events Controller
MET	Mission Elapsed Time
MIA	Multiplexer Interface Adapter
MIL	Merritt Island
MMU	Mass Memory Unit
MPS	Main Propulsion System
MS	Mission Specialist
MSBLS	Microwave Scan Beam Landing System
NH ₃	Ammonia
OBS	Operational Biomed System
OFT	Orbital Flight Test
OMS	Orbital Maneuvering System
ORR	Orroral
PASS	Primary Avionics Software System
PBI	Pushbutton Indicator
PCM	Pulse-Code Modulation
PCS	Pressure Control System
PDP	Post Insertion Deorbit Prep Checklist
PLBD	Payload Bay Door
POS	Portable Oxygen Supply
PS	Payload Specialist
PTC	Passive Thermal Control
RA	Radar Altimeter
RAM	Random Access Memory
RCS	Reaction Control System
RELMAT	Relative Matrix
RGA	Rate Gyro Assembly
RHC	Rotation Hand Controller
RM	Redundancy Management
RPTA	Rudder Pedal Transducer Assembly

SBTC	Speed Brake Thrust Controller
SM	Systems Management
SPD BK	Speed Brake
SPI	Surface Position Indicator
SSME	Space Shuttle Main Engine
ST	Star Tracker
STBD	Starboard
STDN	Space Tracking & Data Network
TACAN	Tactical Air Navigation
TFL	Telemetry Format Load
THC	Translation Hand Controller
TIG	Time of Ignition
UHF	Ultra High Frequency
VTR	Video Tape Recorder
WCS	Waste Collection System

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EVENT/CREW TASK

MIDDECK SWITCH VERIFICATION/CDR

ENTRY SWITCH VERIFICATION/BOTH

TIME

DISPLAY

TIG -2:28
TIG -1:10

N/A

DISCUSSION

Since the crew may inadvertently 'knock' a switch out of its position during suit donning, the middeck switch verification is performed post suit donning.

The middeck switch verification consists of verifying the positions of the switches and valves in the middeck for entry. This activity is performed after all middeck deorbit prep activities have been completed. It is the final deorbit prep activity in the middeck, so the lights are turned off. The crew also stow their wireless headsets.

For the entry switch verification, the crew verifies the positions of the forward and aft switches and cb's to ensure they are in the correct position for entry. The deorbit prep procedures should have made any required changes from the on-orbit to entry configuration. The switch verification occurs before seat ingress.