1. APPLICATION: SWITCH FROM OBC PRIMARY (8K) MEMORY TO THE BACKUP (4K) MEMORY

IMPLEMENTATION RESPONSIBILITY: OD
SUPERCEDES PRIOR FODs: E001C
RESPONDS TO SCARs: N/A

2. DIRECTIVE: THIS DIRECTIVE PROVIDES THE PROPER SEQUENCE OF COMMANDS FOR EMERGENCY SWITCHING CONTROL FROM THE PRIMARY (8K) MEMORY TO THE BACKUP (4K) MEMORY.

1. :IMP 46 /CLOSE SUN SHUTTER IF BETA IS GREATER THAN 110°
2. :OBC GO /STORE INFORMATION FOR DUMP ANALYSIS
3. :OBC RESET /ENSURE OBC NOT RUNNING - LOSE CONTROL
4. :OBC FIX1 /SWITCH TO BANK 1
5. :OBC GO /START OBC

6. :OBC CMND,3,0 /TURN ON H/S WORKER
7. :OBC CMND,9,0 /CMND OBC CONTROL MODE
8. :OBC CMND,3,1 /TURN ON MANEUVER PROCESSOR

PROCEDURE OBCENG PROVIDES THE ABOVE OPERATION EXCEPT THAT IT DOES NOT CLOSE THE SUN SHUTTER.

EXEC OBCENG,1 AT WAIT
GO RESET4K /START PROC EXECUTION

/SWITCHES TO (OR RESETS) 4K MEMORY AND STARTS OPERATION

3. APPROVAL SIGNED: IVAN J. MASON
IUE FLIGHT OPERATIONS DIRECTIVE

1. APPLICATION: SWITCH FROM OBC BACKUP (4K) MEMORY TO THE PRIMARY (8K) MEMORY

IMPLEMENTATION RESPONSIBILITY: OD
SUPERCEDES PRIOR FODs: E002B
RESPONDS TO SCARs: N/A

2. DIRECTIVE: THE FOLLOWING PROVIDES THE SEQUENCE OF COMMANDS TO SWITCH FROM THE OBC BACKUP (4K) MEMORY TO THE PRIMARY (8K) MEMORY.

1. :OBC RESET /ENSURE OBC NOT RUNNING
2. :OBC GO /START OBC
3. :OBC CMND,3,0 /TURN ON HOLD SLEW WORKER
4. :OBC CMND,9,0 /CMD OBC CONTROL MODE
5. :OBC CMND,3,8 /TURN ON WORKER 0 TIME OUT
6. :OBC CMND,14,1 /RATE ARREST: DISARM
7. :OBC CMND,3,9 /TURN ON RATE ARREST WORKER
8. :OBC CMND,3,1 /TURN ON MANEUVER PROCESSOR WORKER
9. :OBC CMND,3,6 /TURN ON MEMORY SUM CHECK WORKER

PROCEDURE OBCENG PROVIDES THE ABOVE OPERATION.

EXEC OBCENG,1 /START PROC EXECUTION
AT WAIT
GO RESET8K /SWITCHES TO (OR RESETS) 8K MEMORY AND STARTS OPERATION.

3. APPROVAL SIGNED: IVAN J. MASON

16 APR. 82
1. APPLICATION: SWITCH FROM ANALOG CONTROL ON WHEELS TO H/S OBC PRIMARY (8K) MEMORY SYSTEM

IMPLEMENTATION RESPONSIBILITY:
SUPERCEDES PRIOR FODs: E004B
RESPONDS TO SCARs: GU074

2. DIRECTIVE: THIS DIRECTIVE PROVIDES THE INSTRUCTIONS TO SWITCH TO OBC PRIMARY (8K) MEMORY CONTROL FROM ANY ANALOG WHEEL MODE:

1. :OBC RESET /ENSURE OBC NOT RUNNING
2. :OBC GO /START OBC
3. EXAMINE SERIAL, RW /ALL WHEELS SHOULD = 128 (P,Y,R)
4. :RW, RWMODE=Φ, RWENAB=1 /NO CONTROL
5. EXAMINE SERIAL, IRA /VERIFY GYRO COMMAND
6. :IRA, IRAMC=29, IRAQB=1 /GYROS IN H/S MODE, PAGE ACSM
7. WAIT 5 SECONDS /VERIFY H/S MODE
8. :RW, RWMODE=11, RWENAB=1 /OBC, HARDWARE OPEN LOOP (VERIFY @Sl, PAGE ACSM)
9. :OBC CMND,3,Φ /TURN ON HOLD SLEW WORKER
10. :OBC CMND,9,Φ /CMND OBC CONTROL MODE
11. :OBC CMND,3,8 /TURN ON WORKER 0 TIMEOUT
12. :OBC CMND,14,1 /RATE ARREST DISARM
13. :OBC CMND,3,9 /TURN ON RATE ARREST WORKER
14. :OBC CMND,3,1 /TURN ON MANEUVER PROCESSOR WORKER
15. :OBC CMND,3,6 /TURN ON MEMORY SUM CHECK WORKER
16. IRAQB=Φ /DISABLE IRA COMMANDING

3. APPROVAL SIGNED: IVAN J. MASON
1. APPLICATION: SWITCH FROM ANALOG CONTROL ON WHEELS TO H/S OBC BACKUP (4K) MEMORY.

IMPLEMENTATION RESPONSIBILITY:
SUPERCEDES PRIOR FODs: E005A
RESPONDS TO SCARS: G0074

2. DIRECTIVE: THIS DIRECTIVE PROVIDES THE INSTRUCTIONS TO SWITCH TO OBC BACKUP (4K) MEMORY CONTROL FROM ANY ANALOG WHEEL MODE:

1. :OBC RESET
2. :OBC FIX1
3. :OBC GO
4. :OBC CMND,11,1
5. EXAMINE SERIAL,RW
6. :RW,RWMODE=Ø,RWENAB=1
7. EXAMINE SERIAL,IRA
8. :IRA,IRAMC=29,IRAQB=1
9. WAIT 5 SECONDS
10. :RW,RWMODE=11,RWENAB=1
11. :OBC CMND,3,Ø
12. :OBC CMND,9,Ø
13. :OBC CMND,3,1
14. IRAQB=Ø

3. APPROVAL SIGNED: IVAN J. MASON
IUE FLIGHT OPERATIONS DIRECTIVE

1. APPLICATION: EMERGENCY SUNACQ AND HOLD ON WHEELS
   IMPLEMENTATION RESPONSIBILITY: 0D
   SUPERCEDES PRIOR FODs: E007C
   RESPONDS TO SCARS: G0074

2. DIRECTIVE: THIS DIRECTIVE IS TO BE USED WHEN DETERMINED NECESSARY TO GO TO HARDWIRE CONTROL. SUNACQ ON WHEELS AND HOLD ON WHEELS.
   NOTE: ASSUMES THAT THE SPACECRAFT IS IN SAFE MODE: C&M,DAC ON.
   A. SUN ACQUISITION ON WHEELS:
      SIMULATIONS INDICATE THIS WOULD BE A SAFE MODE WITHOUT GYRO 1 OPERATING, UNDER MOST CONDITIONS IF GYRO 1 IS OFF AND PROVIDING 0 RATE INTO THE C&M ELECTRONICS.
      NOTE: USE AS A BACKUP TO SUN BATH.
      1. PERFORM SUN ACQ. ON WHEELS AS FOLLOWS:

        :IMP 46
        :CRU OFF,3,14
        :OBC RESET
        IRAGyr=28,IRAMC=8,IRAQB=1
        EXAMINE SERIAL,IRA
        IRA
        RWMODE=2,RWENAB=1
        EXAMINE SERIAL,RW
        RW

        /CLOSE SUN SHUTTER
        /ASSURE JETS ARE OFF
        /ASSURE OBC NOT RUNNING
        /SET UP IRA COMMAND
        /GYRO 3&5 TO RATE MODE
        /SET UP WHEEL COMMAND
        /ENTER SUN ACQ MODE

      THE SPACECRAFT SHOULD MOVE TO BETA=67. THIS MAY TAKE UP TO 25 MIN.

3. APPROVAL  IVAN J. MASON

               22 DEC. 83
1. **APPLICATION:** SWITCH TO OBC WHEEL HOLD FROM OBC PRIMARY (8K) MEMORY CONTROL
   **IMPLEMENTATION RESPONSIBILITY:**
   **SUPERCEDES PRIOR FODs:** E008B
   **RESPONDS TO SCARS:** N/A

2. **DIRECTIVE:** USE THIS DIRECTIVE TO HOLD THE S/C FOR A SHORT TIME PERIOD IN THE EVENT OF GYRO PROBLEM AND RETURN TO HOLD/SLEW

   **A. SWITCH TO OBC WHEEL HOLD**
   1. IMP 46 /CLOSE SUN SHUTTER
   2. OBC CMND,4,0 /TURN OFF HOLD/SLEW WORKER
   3. OBC CMND,3,10 /TURN ON WHEEL HOLD WORKER

   **NOTE:**
   a. THIS WORKER IS NOT AVAILABLE UNDER THE OBC BACKUP (4K) MEMORY CONFIGURATION.
   b. WARNING - ANY S/C DRIFT RATE BUILT UP PRIOR TO SWITCHING TO THIS MODE WILL CONTINUE AT NEARLY THE SAME RATE. OBC HOLDS WHEELS AT TACH RATE PRESENT AT TIME WORKER 10 IS ACTIVATED.

   **B. ADJUST TACH REFERENCE**

   WORKER 10 ESTABLISHES REFERENCE WHEEL SPEEDS AT THE TIME IT IS TURNED ON. IT THEN MAINTAINS THE WHEELS AT THESE REFERENCE VALUES. THE REFERENCES MAY BE ALTERED WITH DATA BLOCK 16. FOR EXAMPLE, IF DUE TO A GYRO PROBLEM THE SPACECRAFT BEGINS MOVING SLOWLY, WORKER 10 MAY BE TURNED ON TO PREVENT THE WHEELS FROM ACCELERATING FURTHER.

   USING WORKER 10 TO STABILIZE THE ATTITUDE WILL WORK ONLY IF THE SPACECRAFT HAS NOT MOVED VERY FAR. FOR THIS REASON, WORKER 10 CONTROL SHOULD NOT BE ATTEMPTED UNLESS THE SPACECRAFT HAS BEEN MOVING SLOWLY (WHEELS NOT SATURATED) FOR LESS THEN 10 MINUTES OR THE WHEELS HAVE BEEN SATURATED FOR LESS THEN 5 MINUTES.

   1. DETERMINE WHEEL REFERENCE TO BE USED - CONVERT WHEEL SPEEDS TO RAW COUNTS.
   Raw counts for reference values can be established by converting the tach RPM's found on page ACSM using the telemetry tables or T&G books. The values used should be from a recent snap when the spacecraft was stable, they are invalid if a maneuver and/or wheel unload is performed in between.

   2. **BUILD DATA BLOCK 16**
   
   
   TACHR(1) = X /PITCH TACH REFERENCE IN RAW CTS.
   TACHR(2) = Y /YAW TACH REFERENCE IN RAW CTS.
   TACHR(3) = Z /ROLL TACH REFERENCE IN RAW CTS.

3. **APPROVAL SIGNED:** IVAN J. MASON
1. **APPLICATION:** SWITCH TO OBC WHEEL HOLD FROM OBC PRIMARY (8K) MEMORY CONTROL
   - **IMPLEMENTATION RESPONSIBILITY:**
   - **SUPERCEDES PRIOR FODs:** E008B
   - **RESPONDS TO SCARS:** N/A

2. **DIRECTIVE:** USE THIS DIRECTIVE TO HOLD THE S/C FOR A SHORT TIME PERIOD IN THE EVENT OF GYRO PROBLEM AND RETURN TO HOLD/SLEW
   - `TACHR(4) = T` /REDUNDANT TACH REFERENCE IN RAW CTS.
   - `BPARDB 16, TACHR, 4` /BUILD DATA BLOCK 16
   - `:OBC LDBLK,16` /UPLINK DATA BLOCK 16

**C. RETURN TO OBC H/S WORKER**

1. `:OBC CMND, 4, 10` /TURN OFF WORKER 10, WHEN H/S OPER.
2. `:OBC CMND, 3, 0` /RETURN TO H/S WORKER, WHEN OPERATIONAL

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3. **APPROVAL SIGNED:** IVAN J. MASON 28 APR. 82
1. APPLICATION: SWITCH FROM PRIMARY TO BACKUP WDA POWER SUPPLIES

IMPLEMENTATION RESPONSIBILITY:
SUPERCEDES PRIOR FODs: E009C
RESPONDS TO SCARs: N/A

2. DIRECTIVE: THIS DIRECTIVE PROVIDES THE INSTRUCTION FOR SWITCHING FROM THE PRIMARY WDA POWER SUPPLIES TO THE BACKUP WDA POWER SUPPLIES.

NOTE: SI & FES SHOULD BE IN SAFE MODE

1. :IMP 46
2. :OBC RESET
3. :CRU OFF,3,14
4. :CRU OFF,26,37,48,51
5. :CRU OFF,4
6. :IMP 65,67,69,71,73,75,77
6. :IMP 79,81,83,85,87,89
7. :CRU ON,15
8. WAIT 20 SECONDS
9. :IMP 88,78,66,68,70,72,76,86
10. HPUL=1,LPUL=1,EVE=1
    EVC=1,FIRE=Ø,
    ENG=2925,VALVE=125
    :EV
11. RWMODE=Ø,RWENAB=1,
    PITCH=128,YAW=128,
    ROLL=128,RED=128,
    :RW
12. :CRU ON,26,37,48
13. GO TO WHEEL SUNBATHING MODE OPERATIONS DIRECTIVE NO. E019.
1. APPLICATION: CONTROL OF IRA DURING LOSS OF CONTROL CONDITION

IMPLEMENTATION RESPONSIBILITY:
SUPERCEDES PRIOR DIDS: E012C
RESPONDS TO SCARs: G0074

2. DIRECTIVE: THIS DIRECTIVE PROVIDES INSTRUCTIONS ON GYRO TEMPERATURE LIMITS AND INSTRUCTION FOR GYRO TURN OFF AND TURN ON IN CASE OF EMERGENCY.

MONITOR ALL GYRO TEMPERATURES

- NOMINAL SET POINTS ARE -         RED-LINE LIMITS
ALL GYROS
GYRO 1 = 60.0  GYRO 4 = 57.0 -10°C & 65°C
GYRO 2 = 56.2  GYRO 5 = 57.0
GYRO 3 = 56.2  GYRO 6 = 55.9

A. MONITOR TEMPERATURES OF ALL GYROS

*** IF CONTROL IS NOT ACHIEVED THE ACS ENGINEER AND OD SHALL DECIDE WHETHER TO TURN OFF GYROS. SHUT DOWN GYROS ONLY IF MANDATORY. TURN OFF ANY GYRO THAT REACHES 75°C.

SET UP GYROS TO BE TURNED OFF BY OMITTING THE APPLICABLE TERM(S) FROM THE FOLLOWING EQUATION, FOR THE GYRO TO BE OFF.

IRAGYR = GY3+GY4+GY5

VERIFY DESIRED GYRO COMMAND CONFIGURATION BEFORE PROCEEDING.

:IRA, IRAQB=1 /TURNS OFF SELECTED GYROS

B. WHEN GYROS ARE AGAIN NEEDED FOR SPACECRAFT CONTROL, TURN ON THREE GYROS REQUIRED BY SENDING THE FOLLOWING COMMANDS IN SEQUENCE.

1. :IRA, IRAQR=GYA, IRAQB=1 /GYRO A ON
   WAIT 30 SECONDS /ASSURE GYRO BEING TURNED ON IS IN SYNC

2. :IRA, IRAQR=GYA+GYB, IRAQB=1 /GYRO A&B ON
   WAIT 30 SECONDS /ASSURE GYRO BEING TURNED ON IS IN SYNC

3. :IRA, IRAQR=GYA+GYB+GYC, IRAQB=1 /GYRO A,B&C ON

4. IRAQB=Ø /INHIBIT IRA COMMANDING

3. APPROVAL

[Signature]
1. APPLICATION: SWITCH IRA FROM COMMON ELECTRONICS 1 TO COMMON ELECTRONICS 2
IMPLEMENTATION RESPONSIBILITY: OD
SUPERCEDES PRIOR FODs: E013C
RESPONDS TO SCARs: G04/4

2. DIRECTIVE: THIS DIRECTIVE PROVIDES INSTRUCTIONS FOR SWITCHING FROM GYROS 1-3-5 TO GYROS 2-4-6 WHEN USING THE ANALOG RATE MODE.

ASSUMPTION: SI AND FES ARE IN A SAFE MODE

1. :IMP 46 /CLOSE SUN SHUTTER
2. :OBC RESET /RESET OBC
3. IRAQyR=0, IRAQB=1 /TURN OFF ALL GYROS
4. :CRU OFF,28 /SWITCH OFF COMMON ELECTRONICS 1
5. :CRU ON,32 /SWITCH ON COMMON ELECTRONICS 2
6. SW IRA,2 /SWITCH COMMAND ADDRESS AND GROUND TELEMETRY FOR COMMON ELECTRONICS 2 IN GROUND COMPUTER.
7. CHECK GYRO TEMPERATURES - SEE NOTES BELOW.
8. GYRO START-UP
   WHEN STARTING GYROS MOVE ON TO NEXT START UP COMMAND AS SOON AS CURRENT DROPS BELOW 250ma ON THE GYRO JUST COMMUNICATED ON.
   a. IRAQB=1 /ENABLE IRA COMMANDING
   b. :IRA, IRAQyR=GY4 WAIT /TURN ON GYRO 4 /VERIFY CURRENT DROP
   c. :IRA, IRAQyR=GY3+GY4 WAIT /TURN ON GYRO 3 /VERIFY CURRENT DROP
   d. :IRA, IRAQyR=GY3+GY4+GY5 WAIT /TURN ON GYRO 5 /VERIFY CURRENT DROP
   e. IRAQB=0 /INHIBIT IRA COMMANDING
9. PROCEED TO WHEEL SUNBATHING SEQUENCE (OPERATIONS DIRECTIVE NO. E019).

3. APPROVAL SIGNED: IVAN J. MASON 21 DEC. 83
1. APPLICATION: SWITCH IRA FROM COMMON ELECTRONICS 1 TO COMMON ELECTRONICS 2
   IMPLEMENTATION RESPONSIBILITY: OD
   SUPERCEDES PRIOR FODs: E013C
   RESPONDS TO SCARs: G0074

2. DIRECTIVE

   NOTE:

   1. GYRO TEMPERATURE IS \(< 26.7^{\circ}C\) \((80^{\circ}F)\), WAIT UNTIL HEATERS RAISE TEMPERATURES
      ABOVE \(26.7^{\circ}C\) BEFORE PROCEEDING.

   2. IF GYRO TEMPERATURES ARE BETWEEN \(26.7^{\circ}C\) \((80^{\circ}F)\) AND \(43^{\circ}C\) \((110^{\circ}F)\) CMD GYROS
      TO RATE COLD.
         :IRA,IRACOLD=1 /RATE COLD MODE

   3. WHEN GYROS ARE BETWEEN \(43^{\circ}C\) \((110^{\circ}F)\) AND \(46^{\circ}C\) \((115^{\circ}F)\) CMD GYROS TO RATE
      NORMAL.
         :IRA,IRACOLD=0 /RATE NORMAL MODE

3. APPROVAL SIGNED: IVAN J. MASON

   21 DEC. 83
1. APPLICATION: SWITCH FROM PRIMARY TO BACKUP ACS DIGITAL-TO-ANALOG CONVERTER
   IMPLEMENTATION RESPONSIBILITY: OD
   SUPERCEDES PRIOR FODs: E014A
   RESPONDS TO SCARS: N/A

2. DIRECTIVE: THIS DIRECTIVE PROVIDES INSTRUCTIONS FOR SWITCHING FROM THE PRIMARY TO THE BACKUP ACS DIGITAL-TO-ANALOG CONVERTER.
   ASSUMPTION: SI AND FES ARE IN A SAFE MODE.

   1. :IMP 46 /CLOSE SUN SHUTTER
   2. :OBC RESET /RESET OBC
   3. :CRU OFF,26,37,48,51 /TURN OFF ALL WHEEL DRIVERS
   4. :IMP 78 /TURN OFF DAC A
   5. :IMP 79 /TURN OFF DAC B
   6. SW RW,2 /SWITCH COMMAND FIELD FOR DAC B
   7. :CRU ON, 26,37,48 /TURN ON WHEEL DRIVERS
   8. RWMODE=0,RWENAB=1,PITCH=128, YAW=128,ROLL=128,RED=128 :RW /RESET DAC B
   9. PROCEED TO WHEEL SUNBATHING MODE (OPERATIONS DIRECTIVE NO. E019 IF NECESSARY).

10. BEFORE RETURNING TO HOLD/SLEW THE FOLLOWING PATCH MUST BE UPLINKED SO THE OBC WILL COMMAND DAC B.

   a. PATCH 8K SYSTEM, TAPE 15
      :OBC GO
      :OBC PATCH,0'7721',0'663140' /OBC COMMANDS TO DAC B

   b. PATCH 4K SYSTEM, TAPE 18F
      :OBC GO
      :OBC PATCH,0'11653',0'663140'

11. RETURN TO HOLD/SLEW OPERATION (OPERATIONS DIRECTIVE E004).

3. APPROVAL SIGNED: IVAN J. MASON
IUE FLIGHT OPERATIONS DIRECTIVE

1. APPLICATION: SWITCH FROM PRIMARY TO BACKUP EVCL/EVD
   IMPLEMENTATION RESPONSIBILITY: SUPERCEDES PRIOR FODs: E015A
   RESPONDS TO SCARS: N/A

2. DIRECTIVE: THIS DIRECTIVE PROVIDES INSTRUCTIONS FOR SWITCHING FROM THE PRIMARY EVCL/EVD TO THE REDUNDANT EVCL/EVD

   1. :IMP 46 /CLOSE SUN SHUTTER
   2. :CRU OFF,3,14 /TURN OFF EVD A,B
   3. IF OUT OF CONTROL SWITCH TO WHEEL SUNBATHING MODE USING OPERATIONS DIRECTIVE F019.
   4. :IMP 88 /TURN OFF EVCL A
   5. :IMP 89 /TURN OFF EVCL B
   6. SW EV,2 /SWITCH COMMAND FIELD FOR EVCL B
   7. HPUL=1,LPUL=1,EVE=1
      EVC=1,FIRE=Ø,ENG=2925,VALVE=125 :EV
   8. :OBC CMND,16,X'80' /SET ACSFLG FOR EVCL B

   NOTES: 1. WHEN USING EVCL B BIT 8 OF ACSFLG SHOULD ALWAYS BE SET TO 1.
           2. EVD #2 IS USED WITH EVCLB.

3. APPROVAL SIGNED: IVAN J. MASON
2. DIRECTIVE:  THIS DIRECTIVE PROVIDES INSTRUCTIONS FOR A SUN ACQUISITION SEQUENCE USING THE OBC (BK) AND JETS. THIS IS TO BE USED ONLY IF THE ANALOG SUN ACQUISITION SYSTEM BECOMES INOPERATIVE DUE TO A CSS AND/OR C&M FAILURE.

EXTREME CAUTION MUST BE USED WHILE IMPLEMENTING THIS DIRECTIVE.

ASSUMPTION:

1. PRIMARY OBC SYSTEM OPERATIVE
2. ANALOG SUN ACQUISITION SYSTEM INOPERATIVE
3. SI AND FES ARE IN A SAFE MODE

1. IMP 46 /CLOSE SUN SHUTTER
2. IMP 76 /TURN OFF C&M CARD
3. :OBC CMND,4,0 /WORKER 0 OFF
4. :IRA,IRAMC=0,IRAQB=1 /PUT ALL THE GYROS IN THE RATE MODE
5. :RW,RWMODE=0,ROWNAB=1 /RW RESET, DISABLES WHEELS CONTROL
6. :CRU ON,3 /EVD 1 ENABLE
7. :OBC CMND,16,0 /SETS ACSFLG TO RATE + POSITION ON ALL AXES
8. :OBC CMND,3,19 /TURN ON WORKER 19

THE SPACECRAFT IS NOW IN RATE + POSITION CONTROL ON ALL AXES. IF THE SUN ATTITUDE IS GOOD, THE PRESENT ATTITUDE SHOULD BE MAINTAINED. IF THE SUN ATTITUDE IS NOT GOOD, THE FOLLOWING SEQUENCE SHOULD BE INITIATED.

9. EXEC DB19,0 /BUILDS DB19 WITH DEFAULT VALUES

10. THE CONTROL LAW IS NOW MODIFIED IN ORDER TO MANEUVER THE SPACECRAFT TO A MORE FAVORABLE SUN ATTITUDE. NOMINALLY, ROLL THE SPACECRAFT FIRST.

   a. ROLL THE SPACECRAFT AT A RATE OF K DEGREES/SECOND.
1. APPLICATION: SINGLE AXIS SUN SEARCH USING OBC

IMPLEMENTATION RESPONSIBILITY: OD

SUPERCEDES PRIOR FODs: E016B

RESPONSSES TO SCARS: N/A

2. Directive

   EXEC MODRA,φ,φ,K /UPLINK ROLL BIAS
   :OBC CMND,16,X'40'
   :OBC CMND,16,φ /ROLL S/C
   :STOP ROLL WHEN FAVORABLE SUN ANGLE IS ACHIEVED, RATE + POSITION HOLD.

   b. IF NECESSARY, PITCH THE SPACECRAFT AT A RATE OF K* DEGS./SECOND.

      EXEC MODRA,K,φ,φ /UPLINK PITCH BIAS
      :OBC CMND,16,X'10'
      :OBC CMND,16,φ /PITCH S/C
      :STOP PITCH WHEN FAVORABLE SUN ANGLE IS ACHIEVED, RATE + POSITION HOLD

   c. IF NECESSARY, YAW THE SPACECRAFT AT A RATE OF K* DEGS./SECOND.

      EXEC MODRA,φ,K,φ /UPLINK YAW BIAS
      :OBC CMND,16,X'20'
      :OBC CMND,16,φ /YAW S/C
      :STOP YAW WHEN FAVORABLE SUN ANGLE IS ACHIEVED, RATE + POSITION HOLD

|K| SHOULD BE +.1 TO +1 DEPENDING ON THE OD'S DISCRETION, K = .1 TO .2 IS RECOMMENDED.

NOTE: SOLAR ARRAY OUTPUT AND FSS SUN PRESENCE SHOULD BE USED AS INDICATORS OF FAVORABLE SUN ANGLE. THE FOLLOWING SEQUENCE IS RECOMMENDED.

1. ROLL UNTIL SOLAR ARRAY CURRENT IS NEAR MAXIMUM OUTPUT, IF FSS SUN PRESENCE IS INDICATED ROLL TO NEAR ZERO.
2. PITCH TO INCREASE SA CURRENT AND STOP WHEN POWER POSITIVE AND FSS SUN PRESENCE IS OBSERVED.

3. APPROVAL

   [Signature]

   22 APR. 82
IUE FLIGHT OPERATIONS DIRECTIVE

1. APPLICATION: RECOVERY FROM UNDERVOLTAGE OR OVERCURRENT AUTOMATIC SYSTEM SHUTDOWN

IMPLEMENTATION RESPONSIBILITY: OD

SUPERCEDES PRIOR FODs: EU17t

RESPONDS TO SCARs: GO074

2. DIRECTIVE: THIS DIRECTIVE PROVIDES INSTRUCTIONS FOR RECOVERY FROM AUTOMATIC SYSTEMS SHUTDOWN IN THE EVENT OF UNDER VOLTAGE OR OVER CURRENT. AUTOMATIC SYSTEM SHUTDOWN WOULD BE CAUSED FROM THE FOLLOWING:

- <26.5V Buss Voltage
- <17 V Battery Voltage
- >12 A Buss Current

A. CHECK FOR AUTOMATIC SYSTEM SHUT-DOWN

THE INDICATION OF AN AUTOMATIC SHUTDOWN WOULD BE LOSS OF TELEMETRY, INCLUDING RF CARRIER, FROM THE SPACECRAFT.

1. CAREFULLY VERIFY ALL GROUND SYSTEMS
2. HAVE GREENBELT SEARCH FOR CARRIER
3. HAVE GREENBELT BRING UP VHF TLM SYSTEM
4. TURN ON VHF SYSTEM
   :IMP 112,120
   EXEC VHF,1
   EXEC TLM,FES2ROM,5
   /CMD DECODERS ON
   /VHF 1 ON, RANGING OFF
   /FORMAT 2A, 5Kb
5. HAVE GREENBELT SEARCH FOR VHF CARRIER AND CHECK FOR MODULATION
6. IF THERE IS NO SIGNAL, HAVE GREENBELT REVERSE THE CMD POLARIZATION AND REPEAT THE ABOVE DECODER, VHF, AND TLM COMMANDS
7. VERIFY THE COMMANDS ARE BEING TRANSMITTED FROM GREENBELT AND CHECK GROUND VERIFICATION.

IF THE ABOVE RESULTS IN A VHF CARRIER BUT NO MODULATION AN AUTOMATIC SPACECRAFT SHUT-DOWN PROBABLY HAS OCCURRED. PROCEED WITH PARA. B.

IF NO RF SIGNAL IS ACHIEVED FROM THE ABOVE, REPEAT THE CHECK USING VHF SYSTEM 2.

   :IMP 112,120
   EXEC VHF,0
   EXEC VHF,2
   EXEC TLM,FES2ROM,5
   /CMD DECODERS ON
   /VHF 1 SYSTEM OFF
   /VHF 2 ON, RANGING OFF
   /FORMAT 2A, 5Kb

REPEAT STEPS A.5, 6 & 7 ABOVE USING VHF SYSTEM 2.

3. APPROVAL SIGNED: IVAN J. MASON

21 DEC. 83

DATE
1. APPLICATION: RECOVERY FROM UNDERVOLTAGE OR OVERCURRENT AUTOMATIC SYSTEM SHUTDOWN

IMPLEMENTATION RESPONSIBILITY: OD

SUPERCEDES PRIOR FODs: E017E

RESPONDS TO SCARs: G0074

2. DIRECTIVE

B. RETURN SYSTEMS ON-LINE AS FOLLOWS:

AS SYSTEMS ARE SWITCHED BACK ON-LINE, CAREFULLY OBSERVE THE S/C CURRENT AND VOLTAGE PARAMETERS TO TRY TO DETERMINE THE CAUSE FOR THE AUTOMATIC SHUTDOWN. WHEN THE FAILED SYSTEM IS TURNED ON THE AUTOMATIC UNLOAD MAY BE REPEATED. REPEAT THIS TURN-ON SEQUENCE, BUT USE THE REDUNDANT SYSTEM FOR THE SYSTEM THAT CAUSED THE FAILURE. ALSO, IF AN UNUSUALLY HIGH INCREASE IN S/C CURRENT OCCURS WHEN A SYSTEM IS TURNED ON, SWITCH IT OFF AND BRING UP THE REDUNDANT SYSTEM.

NOTE: ONCE TELEMETRY IS RESTORED, CAREFUL OBSERVATION OF SYSTEMS STATUS AND PERFORMANCE SHOULD BE MADE BEFORE PROCEEDING, AT EACH STEP.

1. : IMP 112,120 /CMD DECODER ON
2. : CRU ON,9 /SUN SHUTTER ELECT ON
3. : IMP 46 /CLOSE SUN SHUTTER
4. : CRU ON,6 /TURN ON DMU 1 IF REQUIRED,
5. : IMP 31,34,35 /VHF #1 ON MAY BE ON
6. EXEC TLM,FES2ROM,5 /FORMAT 2A, 5Kb FROM PARA. A

STOP

BEFORE PROCEEDING

TELEMETRY SHOULD BE PRESENT
VERIFY ACS SYSTEMS HAVE BEEN SHUT DOWN AND SUN ACQ. IS REQUIRED.

THE FOLLOWING SEQUENCE TURNS ON THE ACS AND INITIATES WHEEL SUNBATHING MODE:

7. : CRU OFF,3,14 /TURN OFF EVD A,B
8. : CRU OFF,26,37,48,51 /TURN OFF WHEEL DRIVERS
9. : CRU ON,21 /TURN ON FSS1
10. : IMP 113 /SELECT FSS1 HEAD 2
11. : CRU ON,53 /TURN ON FSS2
12. : IMP 114 /SELECT FSS2 HEAD 1 (IF REQUIRED)
13. : CRU ON,4 /TURN ON ACS PS1
14. : IMP 77,87,75,65,67,69 /TURN ON C&M, DAC1, EVCL1, PWD, YWD, RWD
15. : CRU ON,28 /TURN ON GYRO CE#1

3. APPROVAL SIGNED: IVAN J. MASON

DATE: 21 DEC. 63
2. DIRECTIVE

16. :CRU ON,27 /GYRO 3 POWER ON
17. :CRU ON,38 /GYRO 4 POWER ON
18. :CRU ON,44 /GYRO 5 POWER ON
19. GYRO START-UP:
   WHEN STARTING GYROS: MOVE ON TO NEXT START-UP COMMAND AS SOON AS CURRENT DROPS BELOW 250 mA ON THE GYRO JUST COMMANDED ON.
   a. :IRA, IRAQB=1, IRAGYR=GY3
      WAIT /START UP GYRO 3
      /VERIFY CURRENT DROP
   b. :IRA, IRAGYR=GY3+GY5
      WAIT /START UP GYROS 3-5
      /VERIFY CURRENT DROP
   c. :IRA, IRAGYR=GY3+GY4+GY5
      WAIT /START UP GYROS 3-4-5
      /VERIFY CURRENT DROP
   d. IRAQB=Ø /INHIBIT IRA COMMANDING
20. :CRU ON,26,37,48 /ARM PY & R WHEEL DRIVERS
   PROCEED WITH WHEEL SUNBATH MODE, FOD E019.
21. AFTER THE SPACECRAFT IS SAFE AND POWER POSITIVE TURN ON GYROS 1, 2 AND 6 HEATERS.
   a. :CRU ON,5 /GYRO 1 POWER ON
   b. :CRU ON,16 /GYRO 2 POWER ON
   c. :CRU ON,60 /GYRO 6 POWER ON
2. DIRECTIVE

ENGINEERING MEETINGS AND SIMULATIONS ARE CONTINUING WITH REGARD TO PROPER EMERGENCY OPERATIONS SINCE GYRO 1 FAILED.

IF IT BECOMES NECESSARY TO GO TO AN EMERGENCY CONTROL MODE USE THE ATTACHED FLOW DIAGRAM TO ESTABLISH WHICH OF THE FOLLOWING RECOVERY MODES TO USE. TABLE 1 GIVES PRIMARY AND SECONDARY CONTROL MODES TO BE USED.

A. SUN BATH:

1. LIMIT THE MOMENTUM STORED IN THE SPACECRAFT WHEELS DURING OPERATIONS SO THIS EMERGENCY CONTROL MODE WILL PERFORM PROPERLY. CONTROL THE WHEEL SPEEDS DURING NORMAL OPERATIONS AS FOLLOWS:
   - YAW AND ROLL WHEEL SPEEDS APPROXIMATELY < 1500 RPM
   - PITCH WHEEL SPEED < 1000 RPM

2. ENTER THE SUN BATH MODE:
   - IMP 46
   - CRU OFF, 3, 14
   - OBC RESET
   - RWMODE=10, RWENAB=1
   - EXAMINE SERIAL, RW
   - RW
   - CLOSE SUN SHUTTER
   - ENSURE EVD'S OFF
   - ENSURE OBC NOT RUNNING
   - SET WHEEL COMMAND FOR SUNBATH
   - VERIFY COMMAND FIELD
   - ENTER THE SUN BATH MODE

   ALL WHEELS MAY GO IN AND OUT OF SATURATION UNTIL THE S/C REACHES BETA 67°. THEN THE YAW OR ROLL WHEEL MAY REMAIN SATURATED. THE S/C PROBABLY WILL SPIN AROUND THE BETA 67° SUN LINE, AT A VERY SLOW RATE.

3. RETURN TO OBC H/S MODE WHEN CONDITIONS PERMIT. USE FOD E004 OR E005.

B. SUN ACQUISITION WHEELS:

SIMULATIONS INDICATE THIS WOULD BE A SAFE MODE WITHOUT GYRO 1 OPERATING, UNDER MOST CONDITIONS IF GYRO 1 IS TURNED OFF AND PROVIDING 0 RATE INTO THE C&M ELECTRONICS. DO NOT USE WITH GYRO 1 OPERATING.

NOTE: USE AS A BACKUP TO SUN BATH.

1. PERFORM SUN ACQ. ON WHEELS AS FOLLOWS:

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1. APPLICATION: GENERAL EMERGENCY OPERATIONS INSTRUCTION
   IMPLEMENTATION RESPONSIBILITY: OD
   SUPERCEDES PRIOR FODs: E018C
   Responds to SCARS: G0074

2. DIRECTIVE

   :IMP 46 /CLOSE SUN SHUTTER
   :CRU OFF,3,14 /ASSURE JETS ARE OFF
   :OBC RESET /ASSURE OBC NOT RUNNING
   IRA=28,IRAMC=8,IRAQB=1, /SET UP IRA COMMAND
   EXAMINE SERIAL,IRA
   :IRA
   RW=2,RWENAB=1 /GYRO 3&5 TO RATE MODE
   EXAMINE SERIAL,RW
   :RW /SET UP WHEEL COMMAND
   /ENTER SUN ACQ MODE

   2. WHEN POSSIBLE RETURN TO THE OBC H/S MODE PER FOD E004 OR E005.

   C. OBC WHEEL HOLD MODE (FOD E008)

   This mode should only be used when the spacecraft has 0 to very low body rates.

   D. OBC RATE & POSITION HOLD AND SINGLE AXIS SUN SEARCH (FOD E016)

   This mode would primarily be used if the C&M electronics, CSS or wheels fail.
   Sun bath and sun acq. modes are preferred, but can not be used if the
   C&M, CSS or wheel devices fail.

   Steps 1-10 of FOD E016 place the S/C in the rate & position mode, used for
   station keeping maneuvers. It will capture and stabilize the S/C for any
   rates that might be introduced during normal operations.

3. APPROVAL IVAN J. MASCN

   22 DEC. 83
1. APPLICATION: GENERAL EMERGENCY OPERATIONS INSTRUCTION
IMPLEMENTATION: RESPONSIBILITY: OD
SUPERCEDES PRIOR EODs: E018C
RESPONDS TO SCARS: 60074

2. DIRECTIVE

IF A C&M, CSS OR WHEEL FAILURE IS SUSPECTED USE STEP 10 WITH GREAT CARE. BUT DO NOT HESITATE TO USE IT IF NECESSARY TO GET THE S/C UNDER CONTROL AND POWER POSITIVE.

ACQUIRE A SAFE ATTITUDE AS FOLLOWS:

```
INITIATE ROLL MANEUVER

HALT MANEUVER AND REVERSE ROLL

ARRAY I INCREASING?

HALT ROLL WHEN ARRAY I IS MAX.

HOLD S/C IS SAFE

FSS SAFE ATTITUDE?

INITIATE + PITCH

HALT PITCH AND REVERSE PITCH

CONTINUE PITCH UNTIL ARRAY I MAX. THEN HALT

FSS SAFE ATTITUDE?

INITIATE ROLL

ARRAY I INCREASE?

HALT ROLL AND REVERSE ROLL

CONTINUE ROLL UNTIL ARRAY I MAX. THEN HALT ROLL

O EVALUATE POWER STATUS
O EVALUATE FSS DATA

INITIATE - PITCH

ARRAY I INCREASE?
```

3. APPROVAL: IVAN J. MASON

[Signature]
1. **APPLICATION: GENERAL EMERGENCY OPERATIONS INSTRUCTIONS**
   IMPLEMENTATION RESPONSIBILITY: OD
   SUPERCEDES PRIOR FODs: EO18C
   RESPONDS TO SCARS: G0074

2. **DIRECTIVE**

   **E.** IN THE EVENT OF A MAJOR SUB-SYSTEM FAILURE (E.G. DMU, POWER, ETC.) AND THE S/C IS OUT OF CONTROL IT MAY BECOME NECESSARY TO REDUCE POWER LOADS TO CONSERVE BATTERY POWER UNTIL BACK-UP SYSTEMS ARE ACTIVATED AND THE S/C IS AGAIN UNDER CONTROL, IN A POWER - POSITIVE POSITION. IF YOU ARE CERTAIN THAT A REDUCTION IN S/C LOAD IS NECESSARY SHUT DOWN THE SI AND OTHER S/C NON-ESSENTIAL EQUIPMENT, AS FOLLOWS:

<table>
<thead>
<tr>
<th>Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP 46</td>
<td>/CLOSE SUN SHUTTER</td>
</tr>
<tr>
<td>EXEC ALLOFF,Ø</td>
<td>/POWER DOWN SI</td>
</tr>
<tr>
<td>EXEC SHADOW,Ø</td>
<td>/TURN OFF NON-ESSENTIAL EQUIPMENT</td>
</tr>
<tr>
<td>EXEC VHF,1</td>
<td>/BRING UP VHF SYSTEM</td>
</tr>
</tbody>
</table>

   DECLARE A S/C EMERGENCY AND HAVE GREENBELT BRING UP VHF SYSTEMS IMMEDIATELY.

   **NOTE:** IF VHF IS NOT AVAILABLE UPON ENTERING SHADOW PROC, ENSURE THAT YOU SKIP THE SECTION WHICH TURNS OFF THE S BAND SYSTEM.

3. **APPROVAL** IVAN J. MASON

   [Signature]

   22 DEC. 83
1. APPLICATION: GENERAL EMERGENCY OPERATIONS INSTRUCTIONS
IMPLEMENTATION RESPONSIBILITY: OD
SUPERCEDES PRIOR FODs: E018C
RESPONDS TO SCARS: G0074

2. DIRECTIVE
TABLE 1: PRIMARY & SECONDARY EMERGENCY CONTROL MODES

<table>
<thead>
<tr>
<th>RECOVERY MODE</th>
<th>NONE</th>
<th>GYRO</th>
<th>WHEEL</th>
<th>JETS</th>
<th>C&amp;M</th>
<th>CSS</th>
<th>COMPUTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. OBC MANEUVERS</td>
<td>Pa</td>
<td>Pa</td>
<td>P</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. SUN ACQ ON WHLS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E007</td>
</tr>
<tr>
<td>3. SUN BATH</td>
<td>Pb</td>
<td>P</td>
<td>Pb</td>
<td>P</td>
<td></td>
<td></td>
<td>E019</td>
</tr>
<tr>
<td>4. OBC WHEEL HOLD</td>
<td>Pc</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td></td>
<td></td>
<td>E008</td>
</tr>
<tr>
<td>5. R&amp;P &amp; SUN SEARCH</td>
<td>P</td>
<td>P</td>
<td>Pd</td>
<td>Pd</td>
<td></td>
<td></td>
<td>E016</td>
</tr>
</tbody>
</table>

P - PRIME
S - SECONDARY

a. IF FSS SUN PRESENCE
b. NO FSS SUN PRESENCE
c. IF VERY LOW S/C BODY RATES & FSS SUN PRES.
d. C&M OR CSS OR WHEEL FAILURE

3. APPROVAL IVAN J. MASON 22 DEC. 83
EMERGENCY MODE SELECTION
1. APPLICATION: SUN BATH, SUN ACQUISITION AND HOLD ON WHEELS
APPLICATION RESPONSIBILITY: OD
SUPERCEDES PRIOR FODs: NONE
RESPONDS TO SCARS: NONE

2. DIRECTIVE: THIS PROCEDURE PERFORMS A SUN ACQUISITION AND HOLD AT BETA 67° USING THE CSS AND WHEEL SYSTEM.

A. SUN BATH:
   1. LIMIT THE MOMENTUM STORED IN THE SPACECRAFT WHEELS DURING OPERATIONS SO THIS EMERGENCY CONTROL MODE WILL PERFORM PROPERLY. CONTROL THE WHEEL SPEEDS DURING NORMAL OPERATIONS AS FOLLOWS:
      YAW AND ROLL WHEEL SPEEDS APPROXIMATELY ≤500 RPM
      PITCH WHEEL SPEED ≤1000 RPM
   2. ENTER THE SUN BATH MODE:
      :IMP 46 /CLOSE SUN SHUTTER
      :CRU OFF,3,14 /ASSURE JETS ARE OFF
      :OBC RESET /ENSURE OBC NOT RUNNING
      RW/MODE=10,RWENAB=1 /SET WHEEL COMMAND FOR SUN BATH
      EXAMINE SERIAL,RW /VERIFY COMMAND FIELD
      :RW /ENTER THE SUN BATH MODE

SUN ACQUISITION AT BETA 67° MAY TAKE ABOUT 20 MINUTES. ALL WHEELS MAY GO IN AND OUT OF SATURATION UNTIL THE S/C REACHES BETA 67°. THEN THE YAW OR ROLL WHEEL MAY REMAIN SATURATED. THE S/C WILL SPIN AROUND THE BETA 67° SUN LINE, AT A VERY SLOW RATE.

3. RETURN TO OBC.H/S MODE WHEN CONDITIONS PERMIT. USE FOD E004 OR E005.

3. APPROVAL SIGNED: IVAN J. MASON

23 APR. 82