BSR 3366

Apollo 17
ALSEP
Array "E"
OPERATIONS PLAN
ATR-341

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Prepared by

BENDIX AEROSPACE SYSTEMS DIVISION

for

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Operations Plan

for

Apollo 17 ALSEP (Array E)

OPERATIONS PLAN

FOR

APOLLO 17 ALSEP (ARRAY E)

1.0 INTRODUCTION

1.1 Purpose and Scope

It is the purpose of this document to present information on the recommended procedures for initializing and maintaining proper operation of that configuration of the Apollo Lunar Surface Experiments Package designated Apollo 17 ALSEP (Array E) and hereinafter referred to as Array E.

The information is presented in a form intended to be used in support of a system operating on the lunar surface where the system performance data presentation and the system control facilities are those provided in the ALSEP control room of Mission Control Center at NASA-MSC.

1.2 Reference Documentation

The information in this document is limited to operational and contingency procedures pertaining to Array E after it has been properly deployed on the lunar surface. Documentation of a more descriptive content or relevant to other operational phases are listed below.

1.2.1 Contractor Documents

(a) Apollo 17 ALSEP (Array E) Familiarization Course Handout BSR 3270

(b) Array E Deployment Operations - ATM 1073

(c) Array E Deployment Contingencies - ATM 1102

1.2.2 Government Documents

(a) Deployment Criteria for Lunar Surface Experiments (Apollo 17)

(b) ALSEP Console Handbook

(c) Final Systems Mission Rules for ALSEP Array E

(d) Mission Requirements, J-3 Type Mission - MSC-05180

(e) Science Contingency Procedures - Apollo 17

(f) CSM/LM Spacecraft Operational Data Book
Volume V: ALSEP Data Book
Appendix F: Apollo 17 ALSEP Array E

2.0 OPERATIONAL PROCEDURES

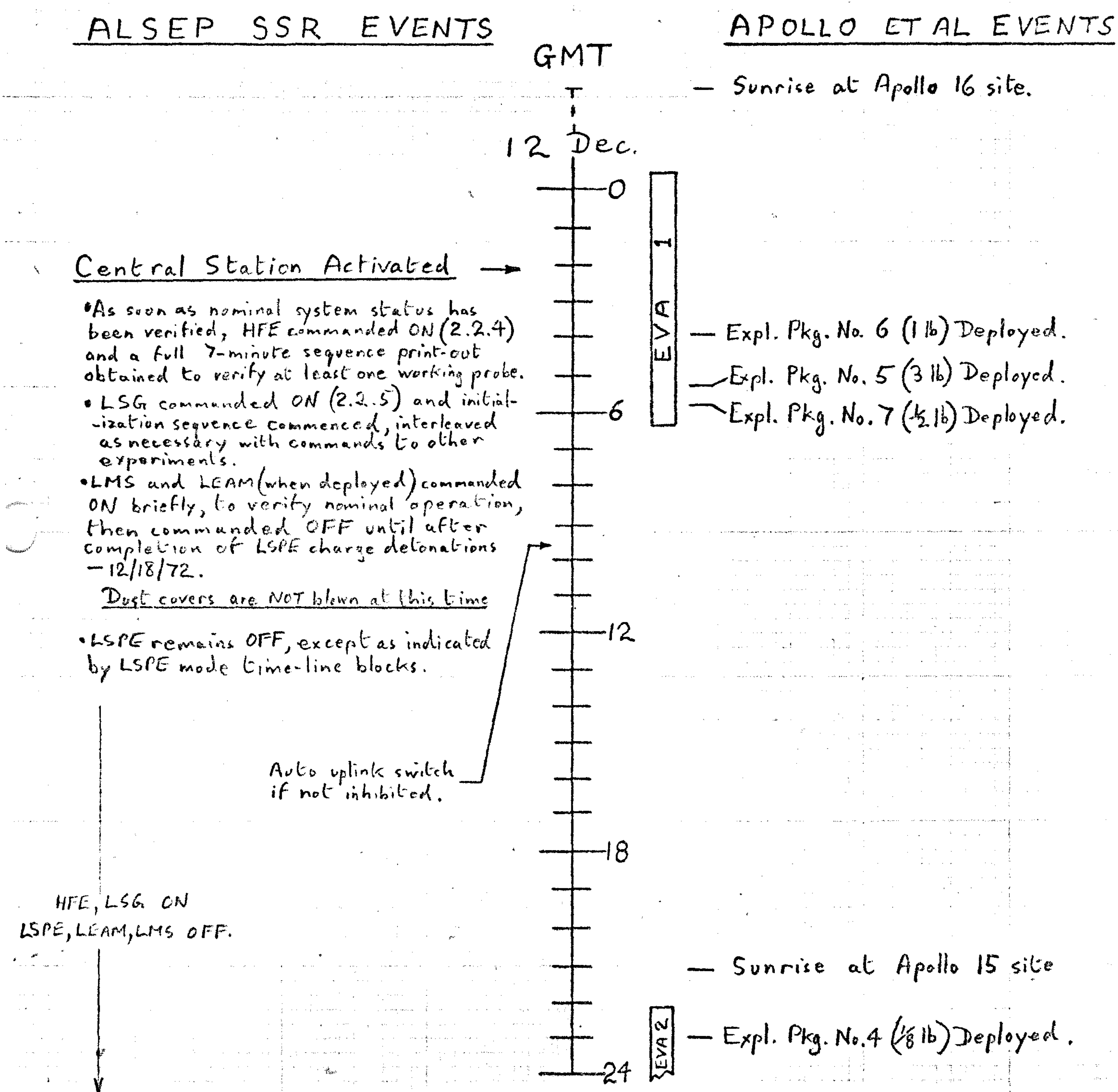
This section contains information on the sequence of events and activities which are necessary for the proper operation of Array E. A general overview of the major operational events during the first lunar daytime is given in Section 2.1. Step-by-step procedures describing the initialization sequence for each item of Array E are presented in Section 2.2. In Section 2.3 are listed the control activities which must be performed periodically after the system has been set into normal operation.

2.1 ARRAY E EVENTS DURING APOLLO 17 MISSION

The first few days of Array E operation are the most critical, not only because of the extensive command activity required to put the system into operation, but also because of the necessity to conduct these operations within the constraints of the Apollo 17 mission priorities and the maintenance of existing ALSEP (and P&FS) systems. To provide some perspective on the interation of ALSEP and Apollo 17 events during the period from ALSEP deployment to Apollo splashdown, the following pages identify the gross sequance of events as derived from available information on the Apollo 17 mission.

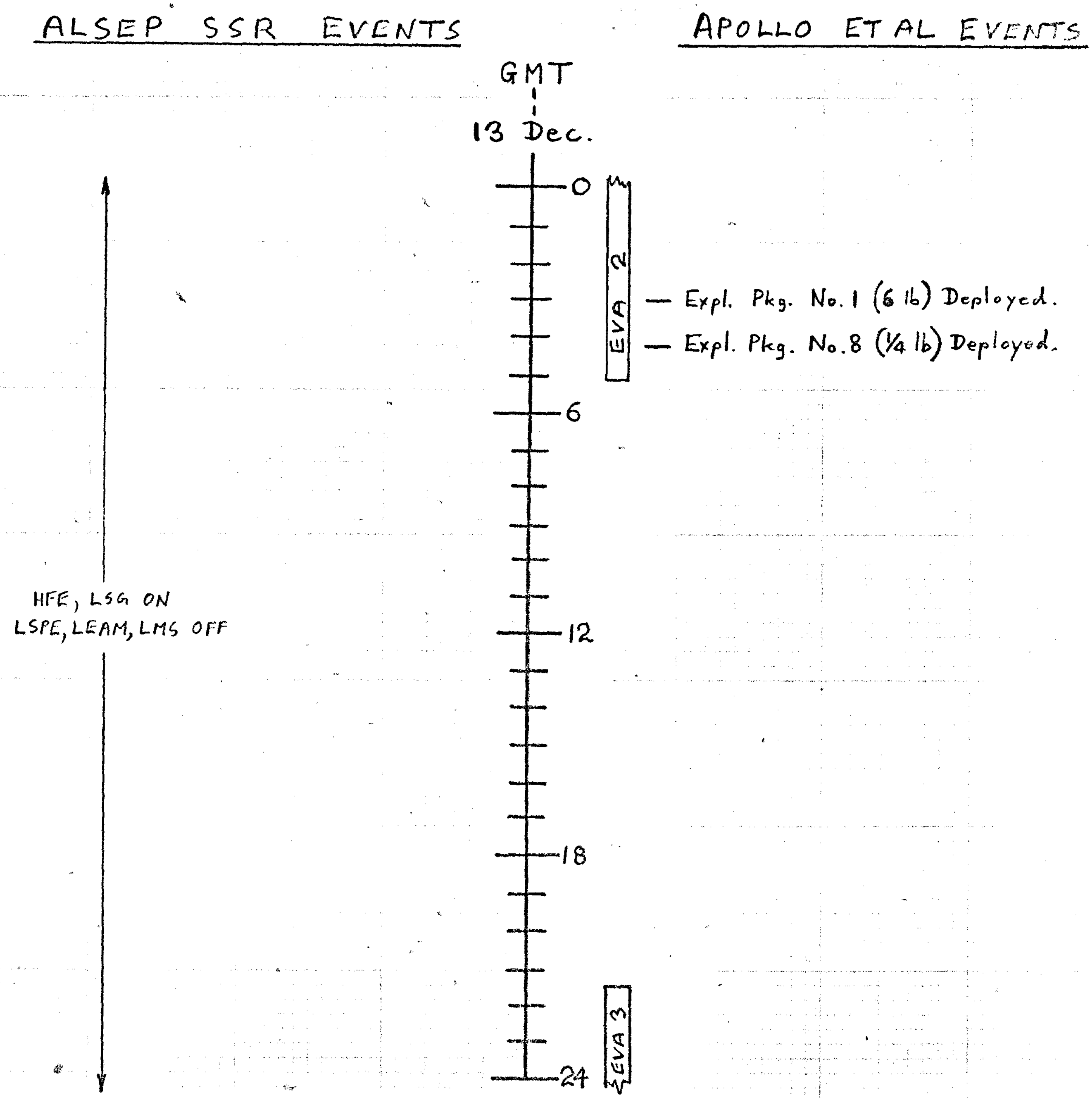
The nominal times of the various events have been plotted as accurately as possible, but deviations in real time may be expected. Note in particular that the detonation times of the LSPE explosive packages are directly related to their individual times of deployment, and also note that the times of possible automatic uplink switches are directly related to the time of application of power to ALSEP. The rules and data which are necessary to determine changes to the time line will be found in the documents listed in Sections 1.2.1 and 1.2.2.

TABLE 2.1(a) INITIAL OPERATIONS SEQUENCE.



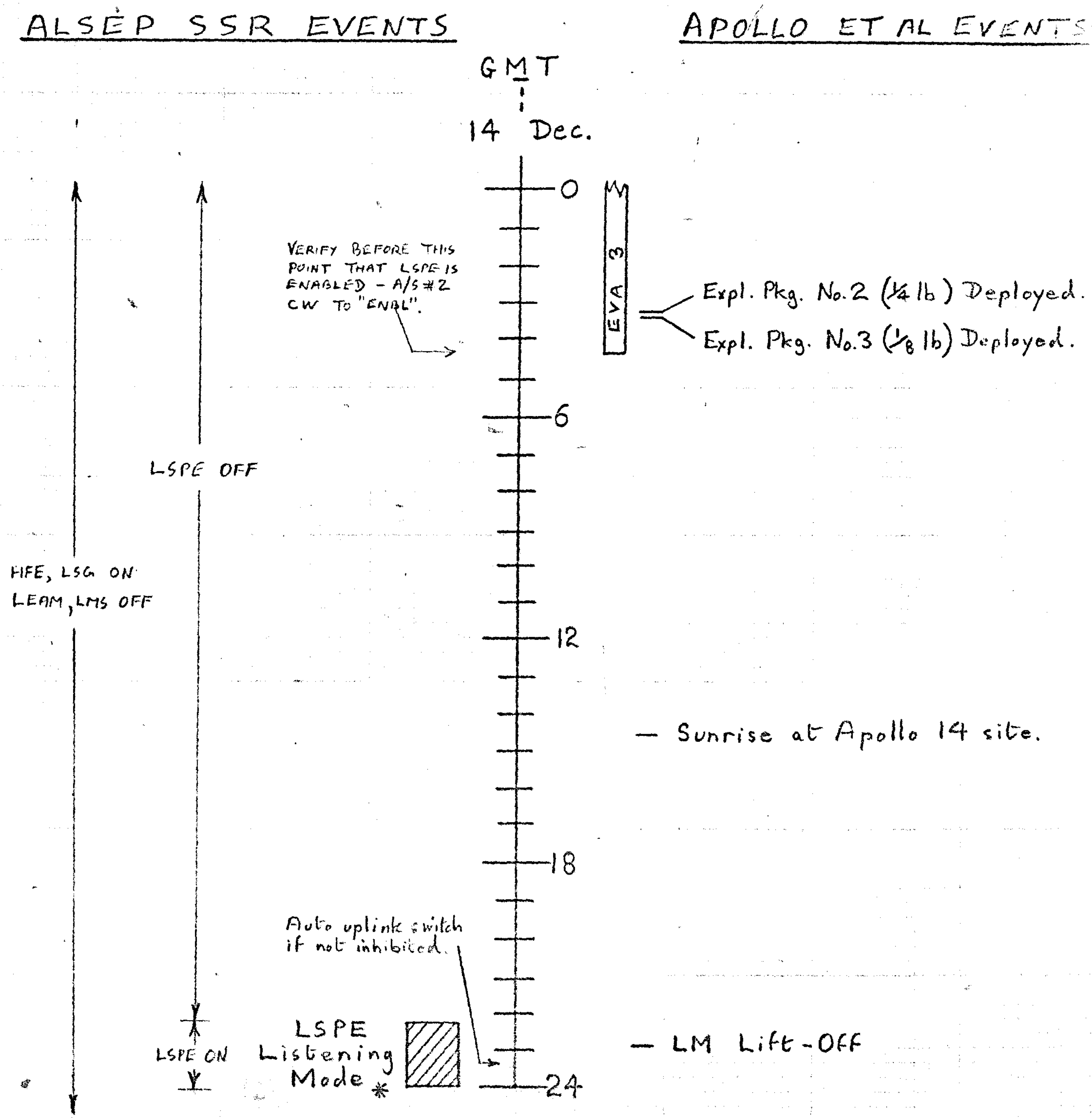
(GMT = CST + 6 HOURS)

TABLE 2.1 (b) INITIAL OPERATIONS SEQUENCE.



(GMT = CST + 6 HOURS)

TABLE 2.1 (c) INITIAL OPERATIONS SEQUENCE

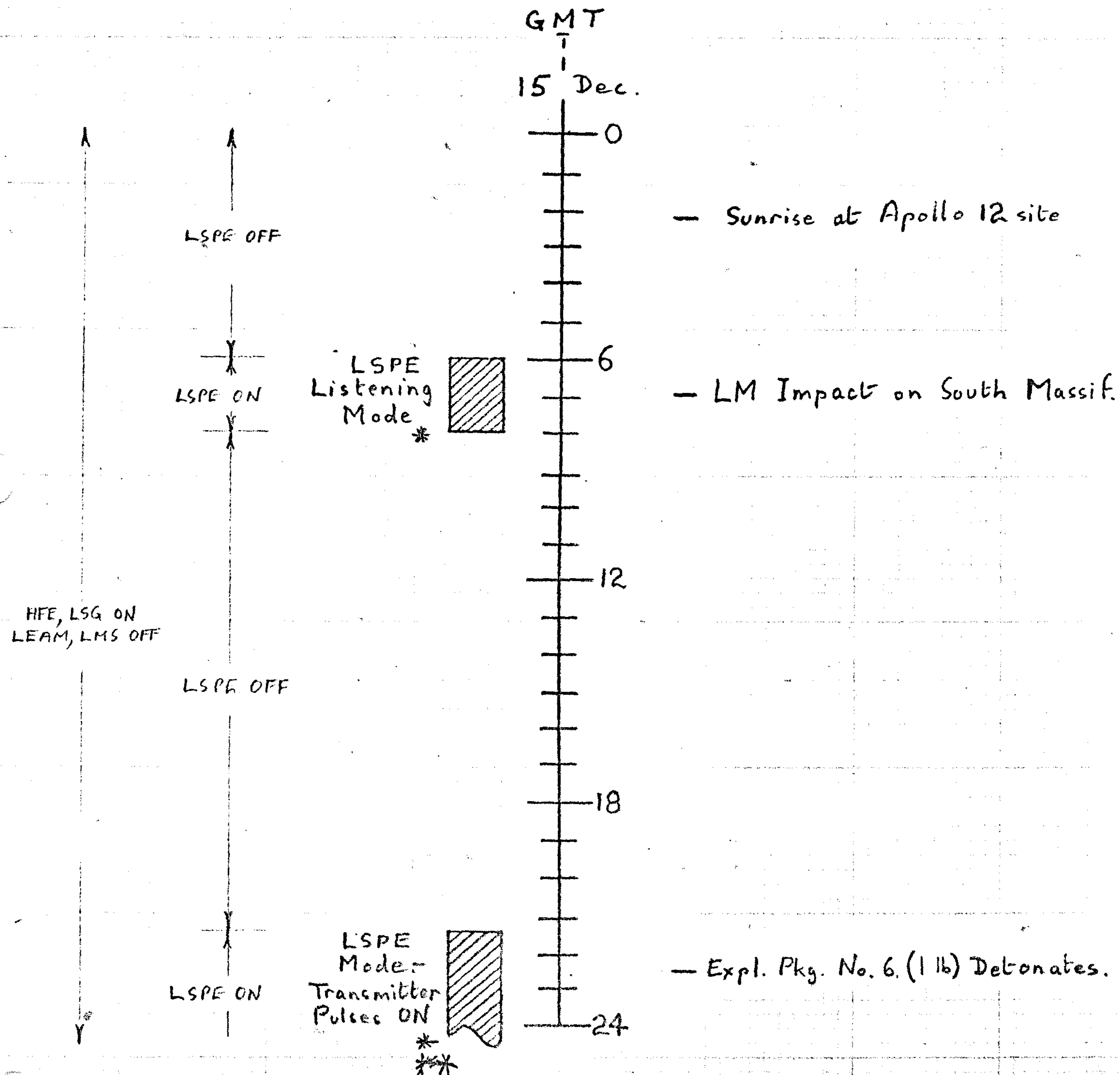


(GMT = CST + 6 HOURS)

* DURING LSPE FORMATTING PERIODS, DATA FROM OTHER EXPERIMENTS IS NOT TRANSMITTED. IT MAY BE DESIRABLE TO COMMAND HFE AND/OR LSG TEMPORARILY TO OFF OR STANDBY, BUT THERE IS NO GENERAL SYSTEM REQUIREMENT OR ADVANTAGE IN SO DOING.

TABLE 2.1 (d) INITIAL OPERATIONS SEQUENCE.

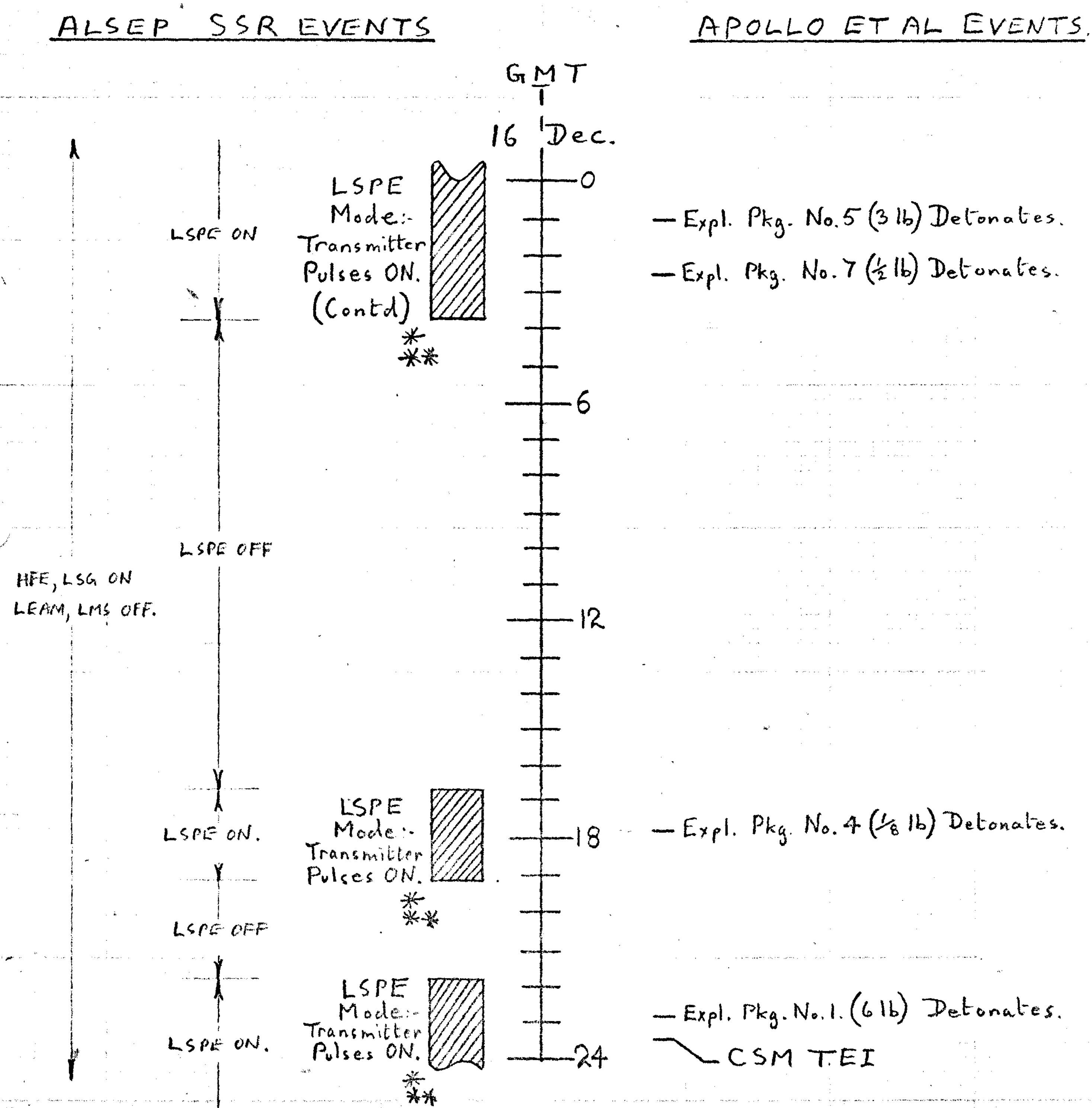
ALSEP SSR EVENTS | APOLLO ET AL EVENTS.



(GMT = CST + 6 HOURS)

* SEE NOTE, TABLE 2.1 (c).
** Actual Transmitter Turn-on time to be determined by Mission Rules.

TABLE 2.1(e) INITIAL OPERATIONS SEQUENCE

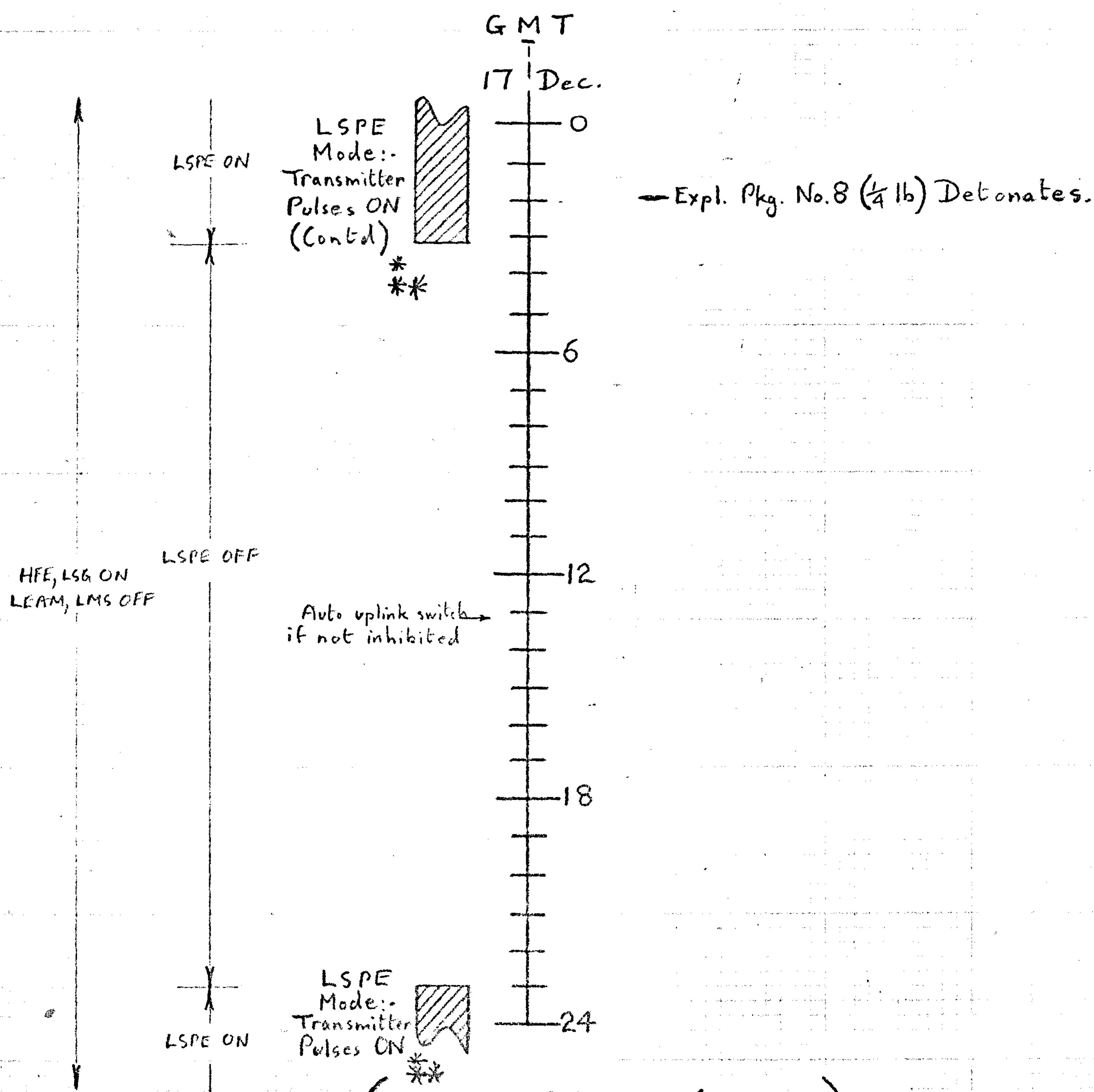


(GMT = CST + 6 HOURS.)

* SEE NOTE, TABLE 2.1(c).
** SEE NOTE, TABLE 2.1(d)

TABLE 2.1 (F) INITIAL OPERATIONS SEQUENCE.

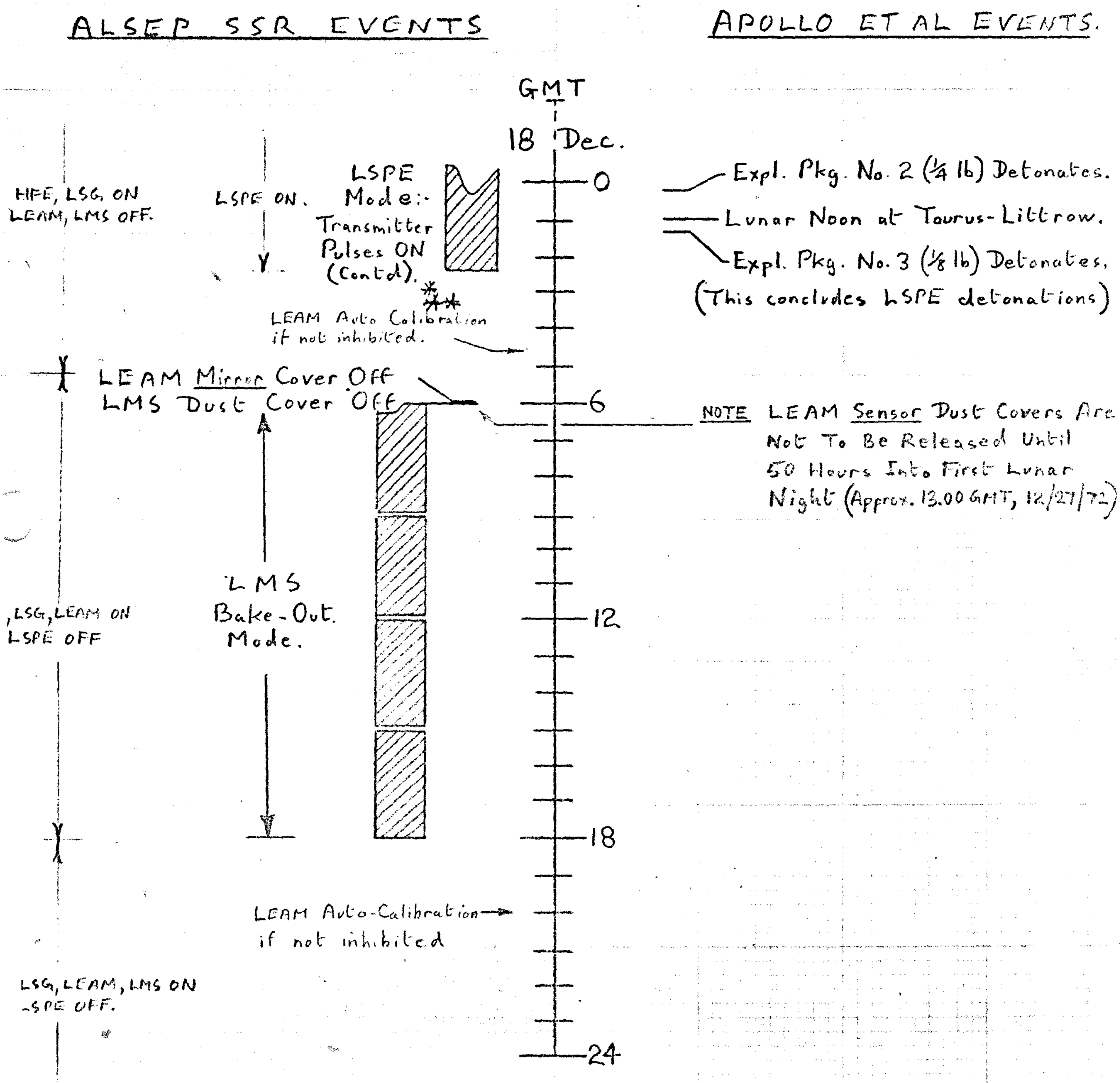
ALSEP SSR EVENTS | APOLLO ET AL EVENTS



(GMT = CST + 6 HOURS)

* SEE NOTE, TABLE 2.1 (c).
** SEE NOTE, TABLE 2.1 (d).

TABLE 2.1 (a) INITIAL OPERATIONS SEQUENCE



(GMT = CST + 6 HOURS)

* SEE NOTE, TABLE 2.1 (c).
* SEE NOTE, TABLE 2.1 (d)

2.2 NORMAL INITIALIZATION PROCEDURES

When power is first applied to ALSEP Array E the system will not necessarily be in what has been designated "normal" operating mode. For this reason, and also to define the operations required to set each scientific sensor into proper operation, this section presents the sequences of commands and expected responses which should take place during the initialization of Array E.

A flow-chart format has been selected for presentation of these procedures because it permits not only the normal sequence of events to be followed concisely, but also the designation of the first level of contingency procedures. These contingency procedures, where identified, are detailed in Section 3. The symbolism used in the flow charts is interpreted in Table 2.2.

For convenience in presentation, the initialization procedures for each of the major subsystems are described separately, as follows:

Central Station - Section 2.2.1

Lunar Mass Spectrometer - Section 2.2.2

Lunar Ejecta and Meteorites - Section 2.2.3

Heat Flow Experiment - Section 2.2.4

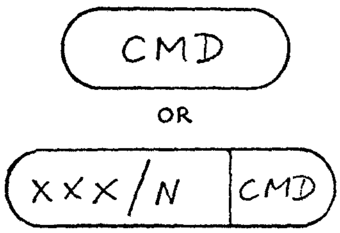
Lunar Surface Gravimeter - Section 2.2.5

Lunar Seismic Profiling - Section 2.2.6

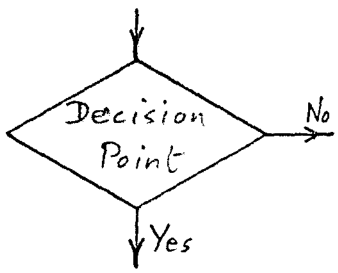
The reader should note that these procedures set forth only the required sequence of events and, unless specifically stated, are not to be interpreted as implying any rate at which the events must occur. It is expected that all six procedures might be in process at any one time and, moreover, all six will be interrupted several times to provide the control activities required by other operating ALSEP systems and Particles and Fields Subsatellites.

TABLE 2.2 Flow-Chart Symbol Interpretation

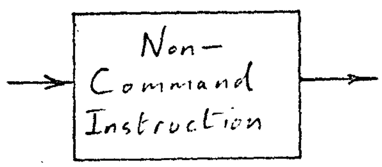
SYMBOL — **INTERPRETATION**



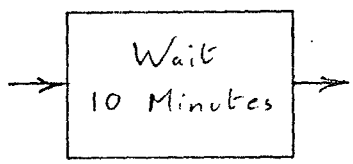
Octal Command (CMD) to be addressed to Array E (ALSEP 5).
In the case of LSG procedures, an abbreviated name of the command is included (XXX) together with the number of times (N) the CMD is to be sent (if more than once) at that step in the procedure.



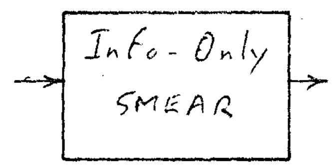
A statement of expected condition, usually as a result of previous actions. If the actual condition corresponds to the stated condition (YES) follow the normal operating procedure. If the system condition is not as stated (NO), either an anomalous condition is indicated or it is necessary to wait until the condition pertains.

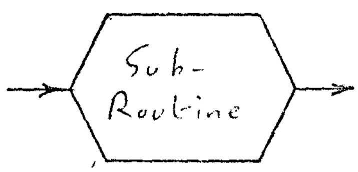


Instruction as to action (other than the issuing of a command) which is to be performed before continuing with the normal procedure. For example:



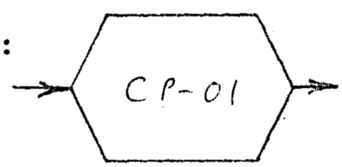
OR



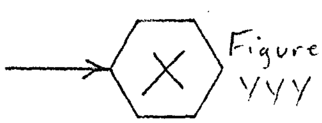


A special procedure of a normal or a contingency purpose, whose detailed steps are defined in the text.

Example:



Contingency Procedure 01 (See Section 3)



A tie-point: where the procedure may jump to a point on another page. The relevant link is found on the page or figure number noted beside the tie-point.

2.2.1 Central Station Initialization

The procedure covered in this section deals only with those conditions pertaining to establishment of: (a) proper uplink and downlink communications with Array E, and (b) the normal operating configuration of the Central Station.

Following the last Earth-based operation of Array E, at NASA-KSC, the system is powered-down in accordance with Bx Procedure TCP 2368907. That procedure is designed to ensure that Array E is in the configuration shown in Table 2.2-1, when power is first applied during lunar operations. In contrast to previous arrays this is not in every case "normal" configuration for Array E and the following procedure describes those steps to be taken to establish "normal" configuration.

The first level of contingency decisions are included in the flow diagram of the procedure (Figure 2.2-1), and, where appropriate, reference is made to the recommended contingency procedure (CP) presented in Section 3.

TABLE 2.2-1

CENTRAL STATION INITIAL CONFIGURATION

Central Station Unit	Initial Status
Downlink	
o Transmitter A	ON
o Transmitter B	OFF
o DDP Active	X
o ADP	
- Active ADP	X
- ADP Power Routing	PRI (W)
Uplink	
o Active Receiver/Decoder	A
o Uplink Power Routing	PRI (W)
o Automatic Uplink Transfer	ENABLED
Power Distribution	
o Experiment Power	
- LMS, LEAM, HFE, LSG	OFF
- LSP	STANDBY
o External Dissipations (7W and 14W Dumps)	OFF
o Active PCU	#1
o PC Auto Select	#1
o APM*	ON
Periodic Commands	ENABLED
Astronaut Switches	
o #1	CCW, AT "PWR"
o #2	CCW, AT "DSBL"

*The APM is known to be subject to uncertain status at turn-on and PC changeover. The required status is ON.

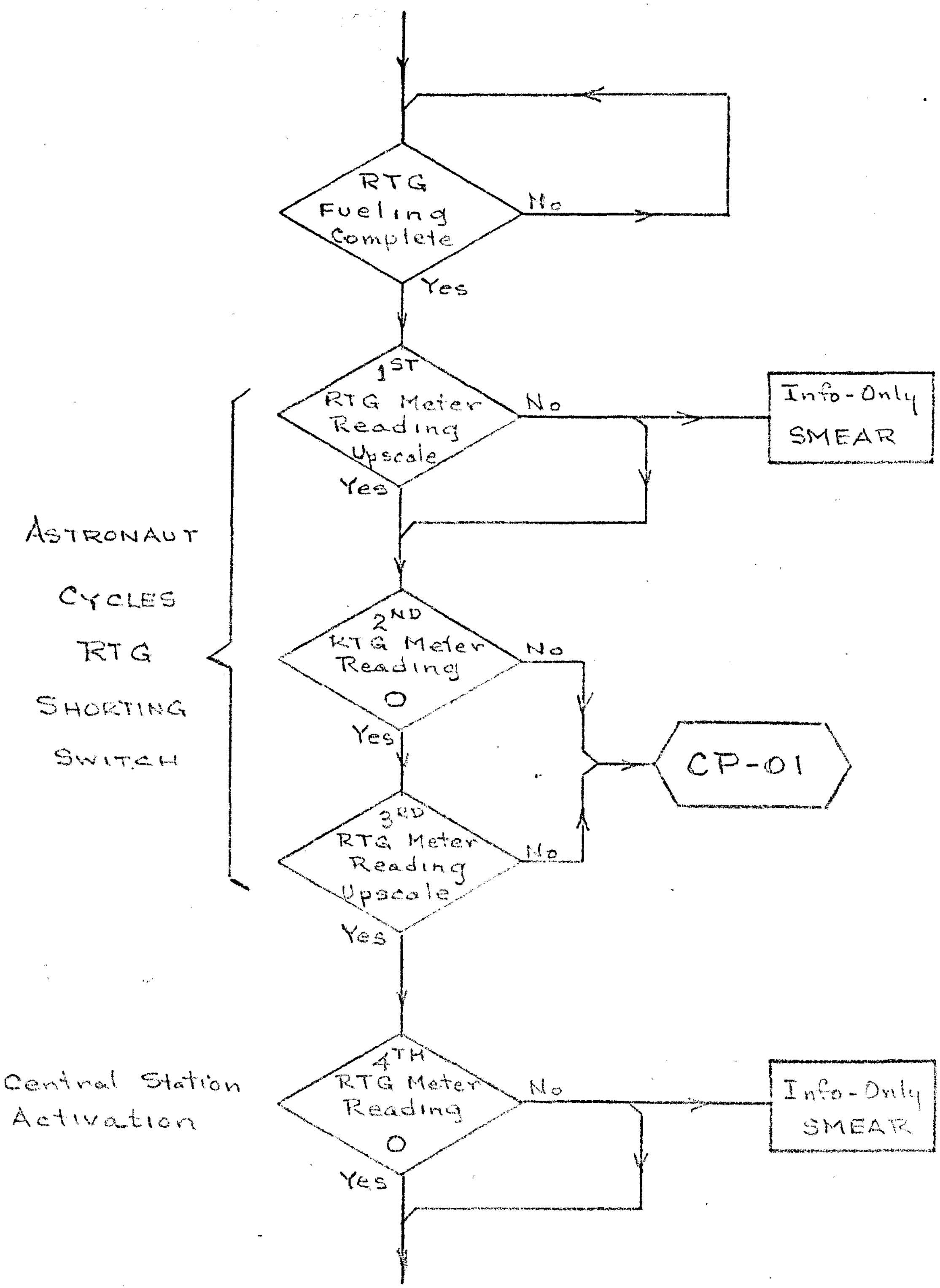


Figure 2.2-1 (a) Central Station Activation

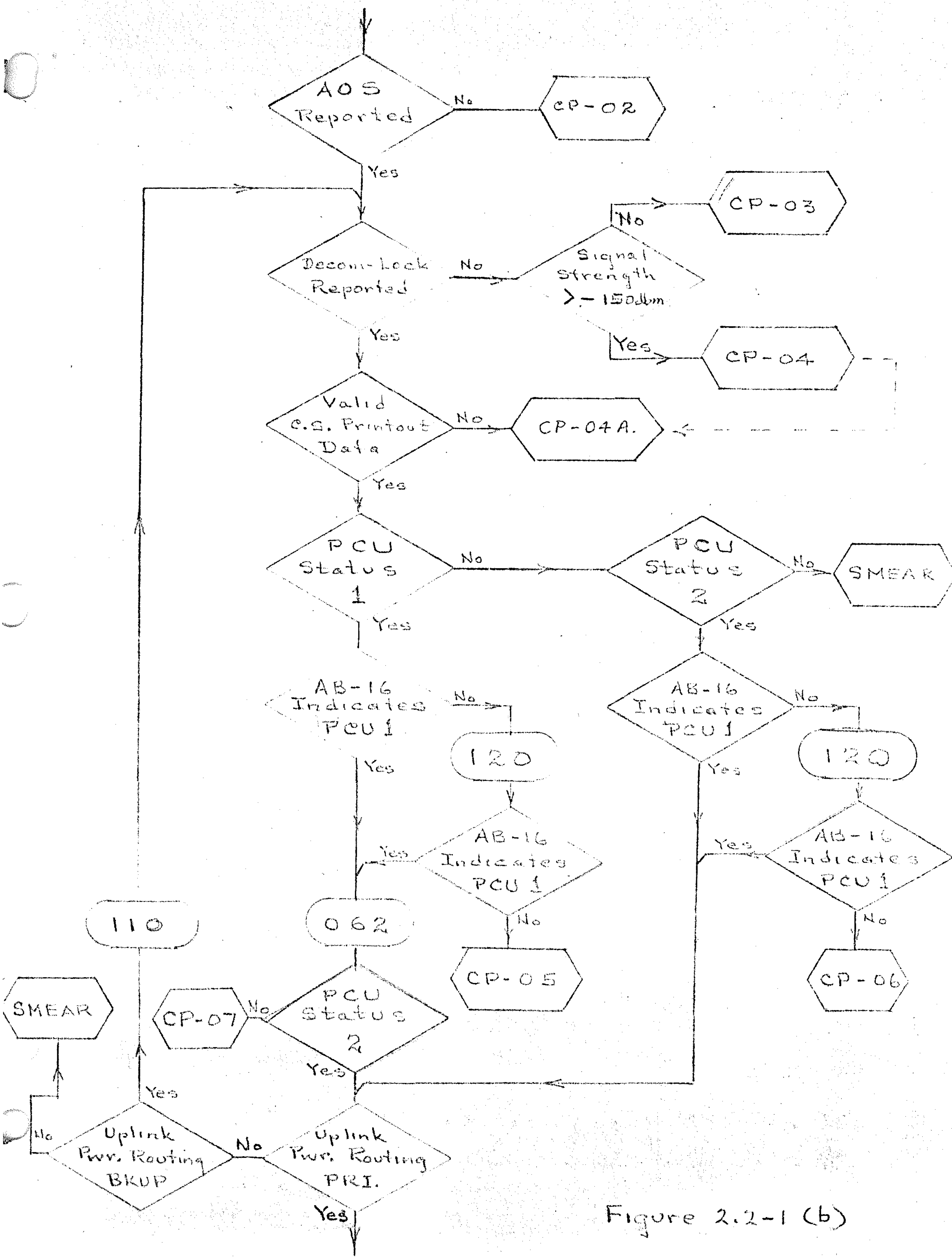
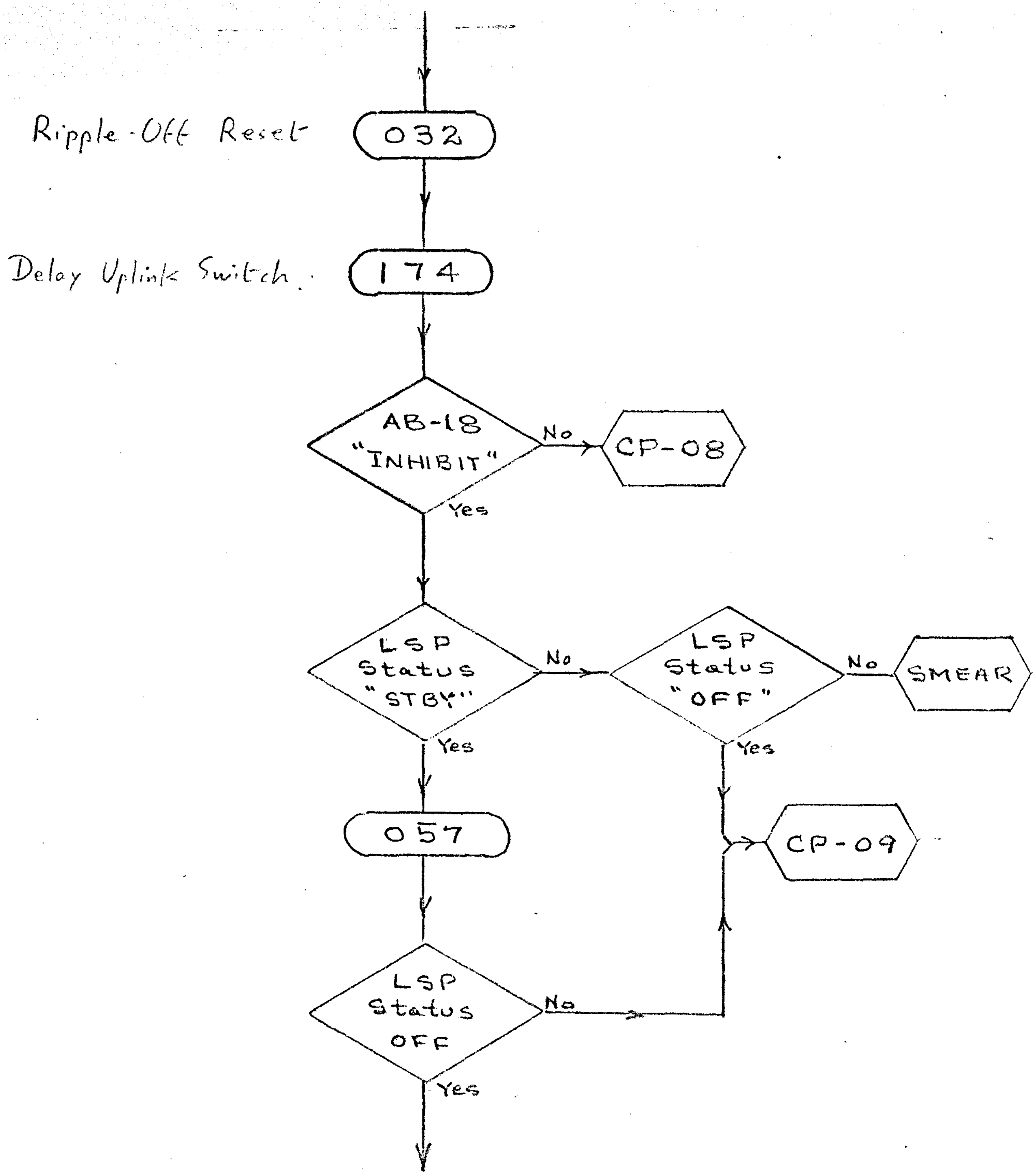

AOS Reported
No
CP-02
Yes
Decom-Lock Reported
No
Signal Strength > -150dbm
No
CP-03
Yes
CP-04
Yes
Valid C.S. Printout Data
No
CP-04A.
Yes
PCU Status 1
No
PCU Status 2
No
SMEAR
Yes
Yes
AB-16 Indicates PCU 1
No
120
Yes
AB-16 Indicates PCU 1
No
120
Yes
AB-16 Indicates PCU 1
Yes
No
CP-05
AB-16 Indicates PCU 1
Yes
No
CP-06
110
062
SMEAR
CP-07
No
PCU Status 2
Yes
Yes
No
Uplink Pwr. Routing BKUP
No
Uplink Pwr. Routing PRI.
Yes

Figure 2.2-1 (b)



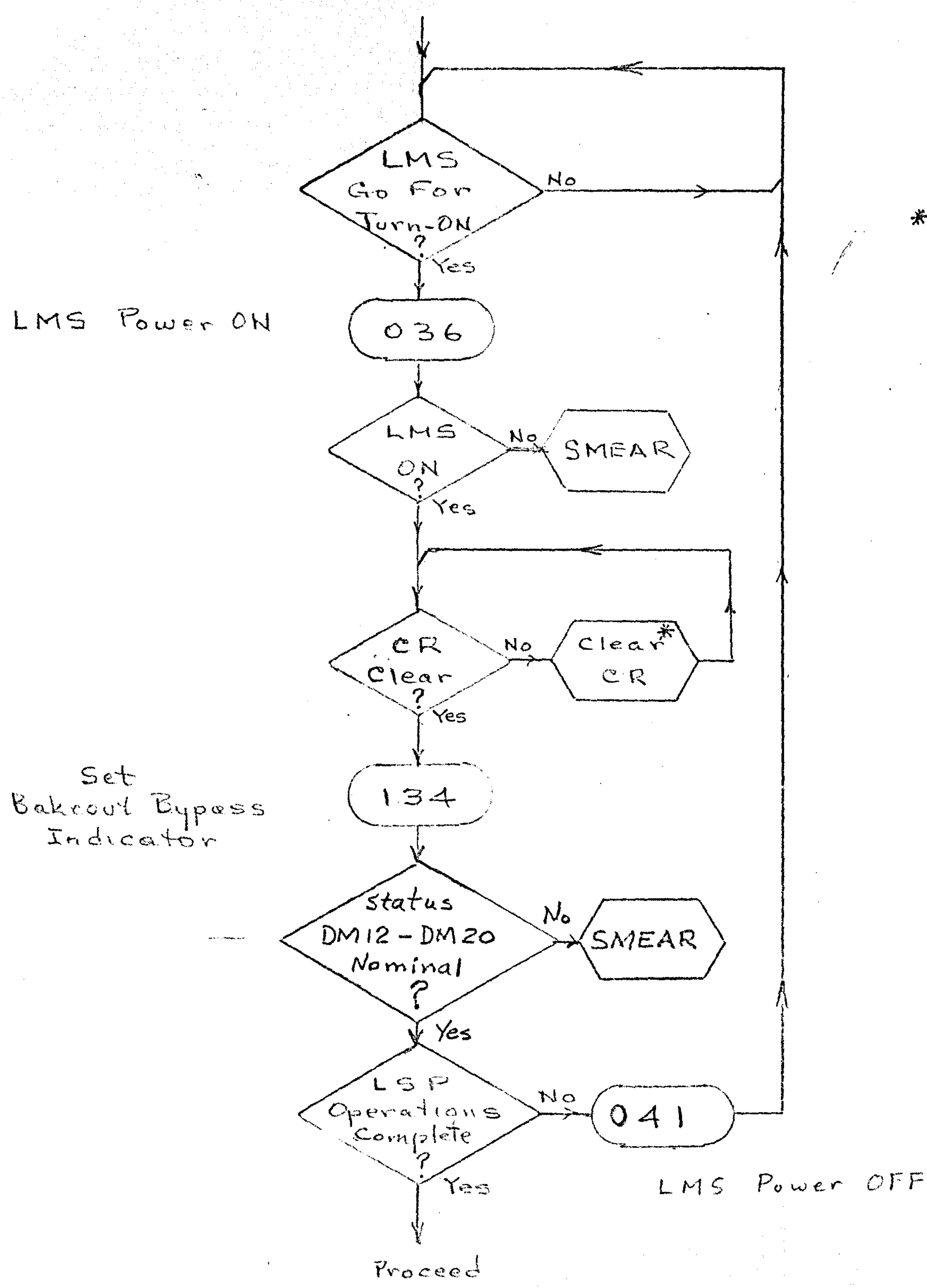
- Confirm that A/S #2 may be safely turned CW, to "ENBL".
- Proceed immediately to HFE initialization sequence (2.2.4).

Figure 2.2-1 (c)

2.2.2 LMS Initialization

The Lunar Mass Spectrometer will be activated briefly during the first hours of ALSEP operation to verify nominal engineering operation. Following completion of the LSP coverage of the explosive package detonations, LMS will be activated, its dust cover removed by command and bake-out of the analyzer begun. Full operation of LMS is not scheduled to begin until near sunset of that first lunar day.

The recommended operational sequence for this initialization phase for LMS is presented in flow-chart format in Figure 2.2-2



* Command Register (CR) is cleared by filling register with all 1's, by command, then transmitting Octal Command 134.

Figure 2.2-2 (a) LMS Initialization

(The sequence on this page is to be performed shortly after Central Station activation, then again after the completion of the LSPE charge detonations).

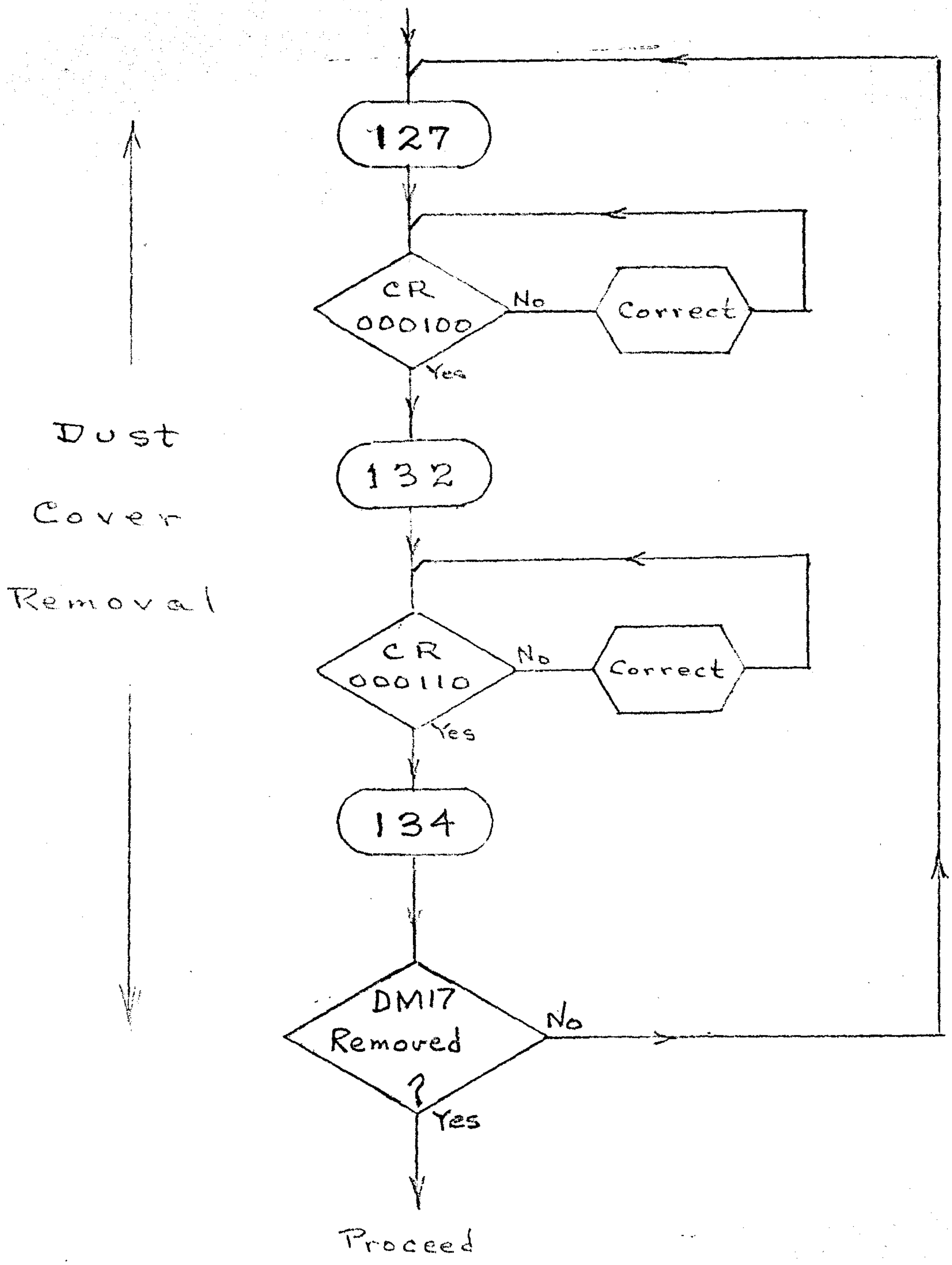


Figure 2.2-2 (b) LMS Initialization

(The sequence on this page through Figure 2.2-2 (g) is not to be performed until after the completion of the LSPE charge detonations)

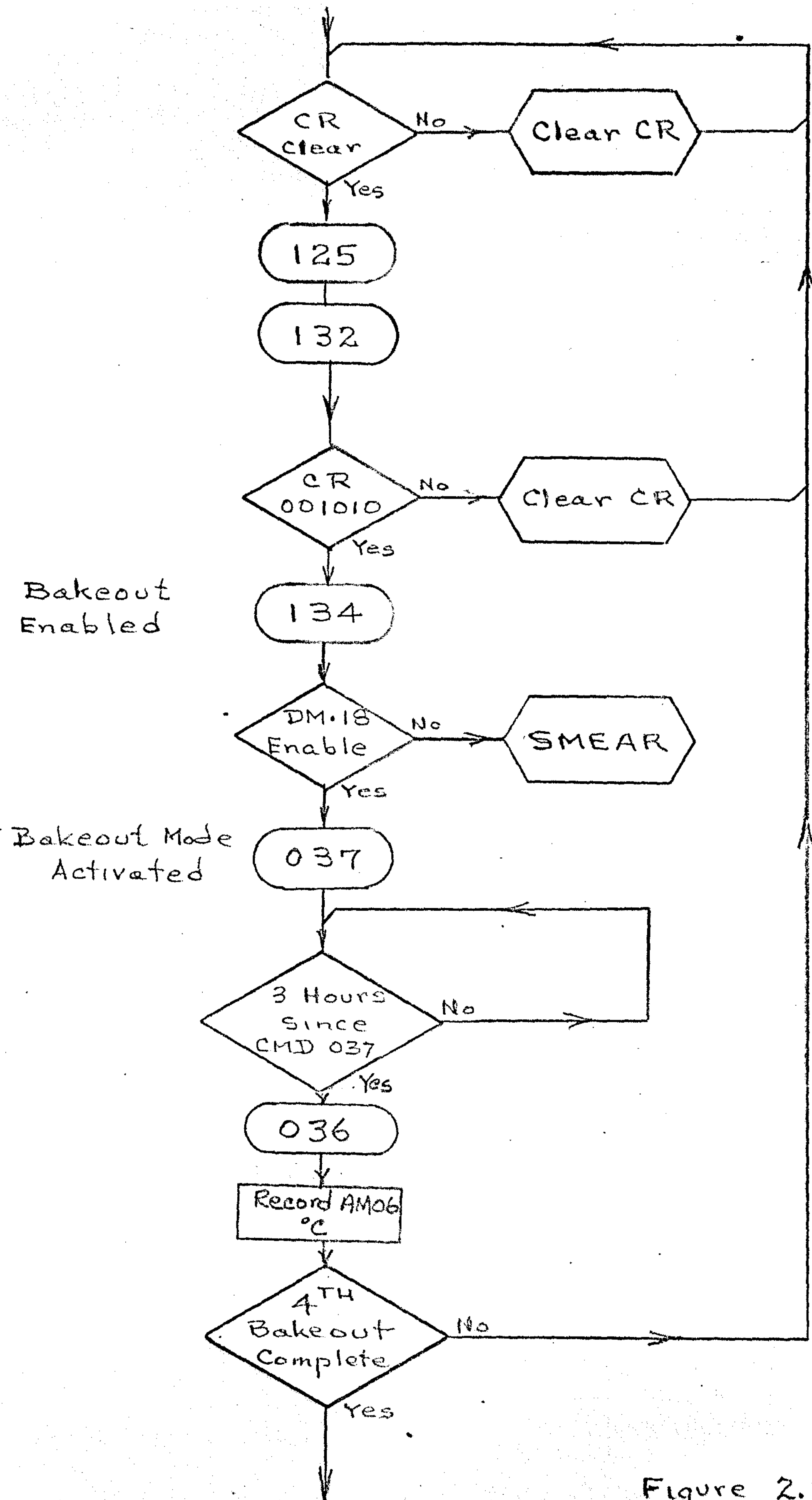

CR Clear
No
Clear CR
Yes
125
132
CR 001010
No
Clear CR
Yes
Bakeout Enabled
134
DM·18 Enable
No
SMEAR
Yes
Bakeout Mode Activated
037
3 Hours Since CMD 037
No
Yes
036
Record AM06 °C
4TH Bakeout Complete
No
Yes

Figure 2.2-2 (c)

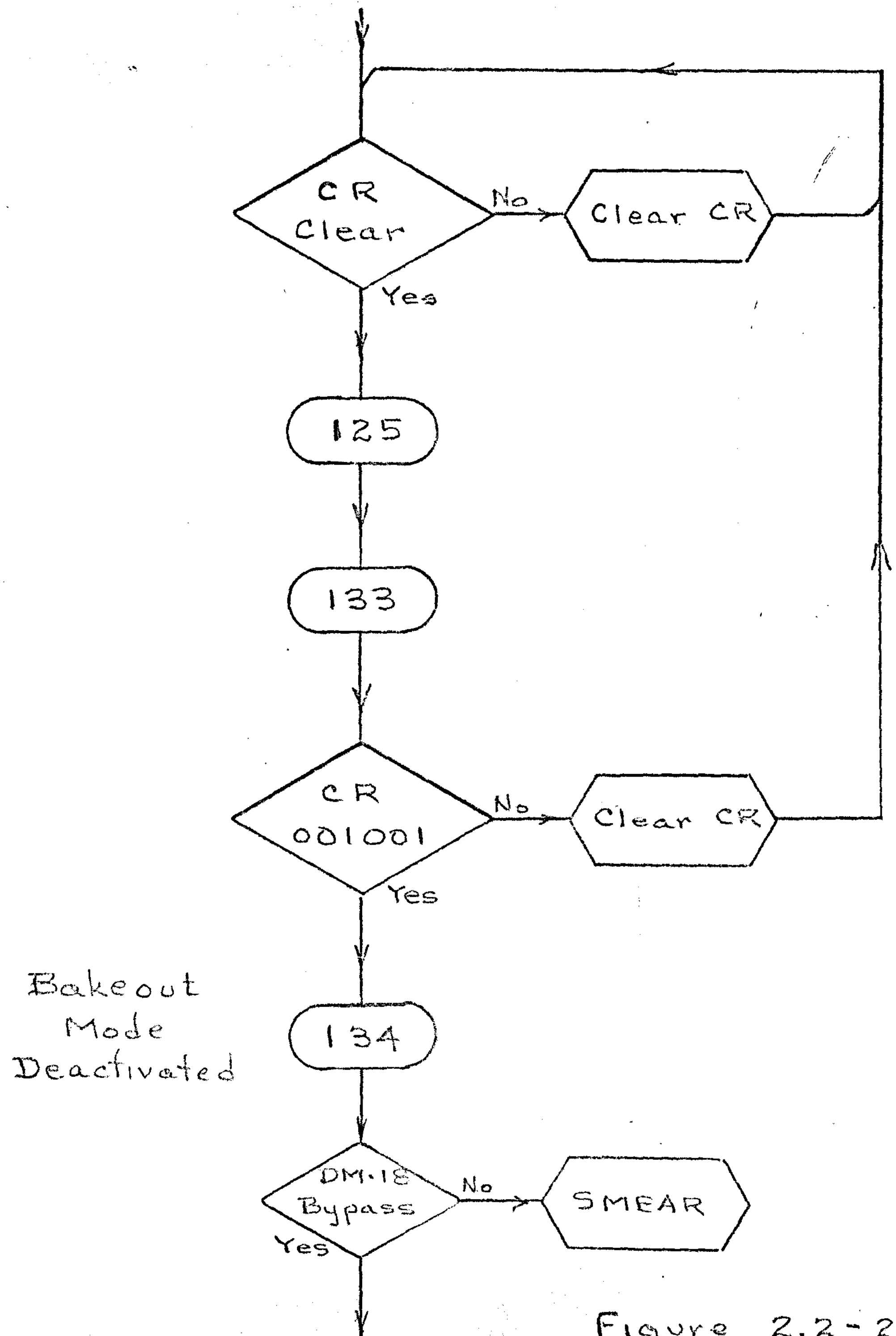

CR Clear
No
Clear CR
Yes
125
133
CR 001001
No
Clear CR
Yes
Bakeout Mode Deactivated
134
DM-18 Bypass
No
SMEAR
Yes

Figure 2.2-2 (d)

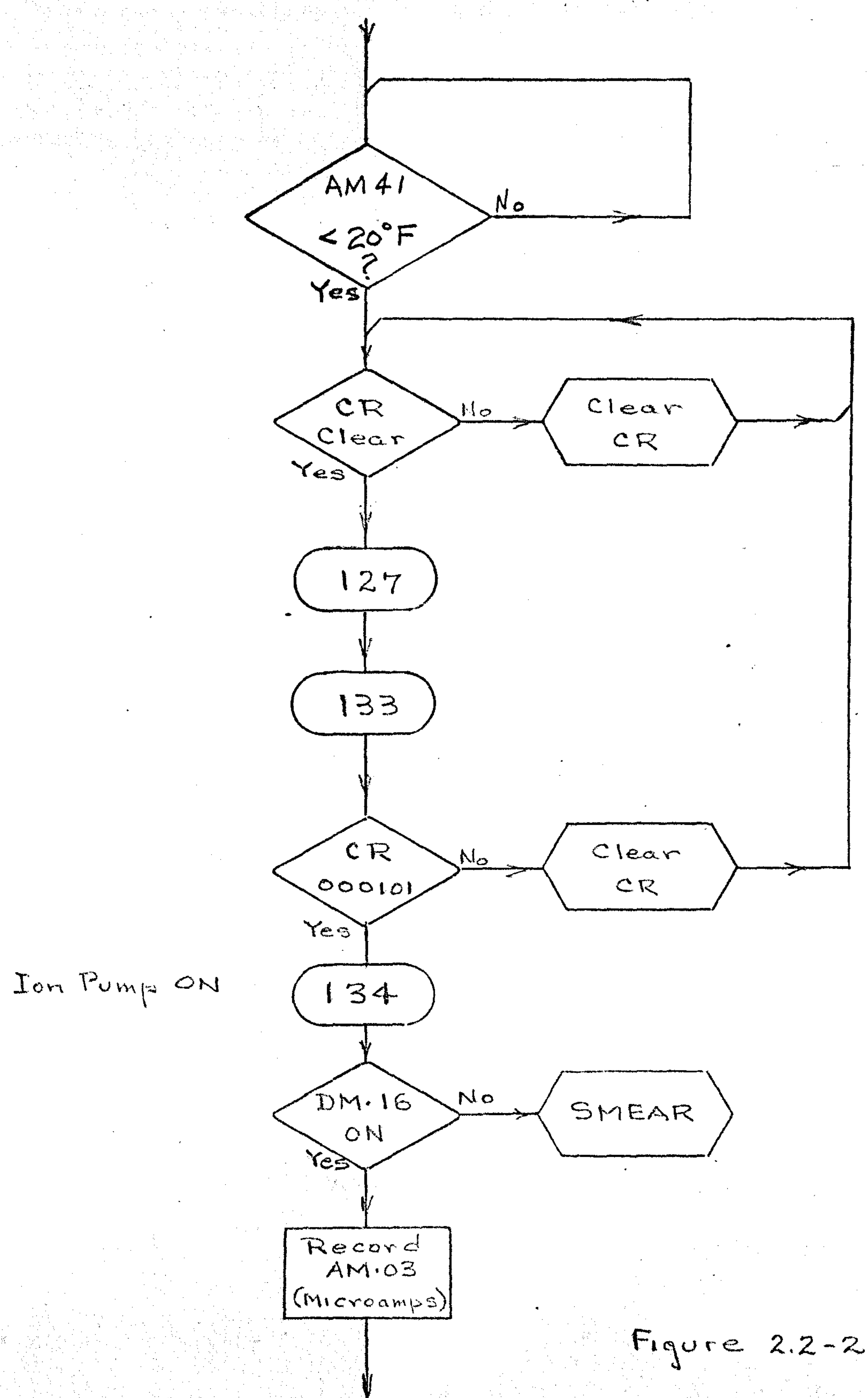

AM 41 < 20°F ?
No
Yes
CR Clear
No
Clear CR
Yes
127
133
CR 000101
No
Clear CR
Yes
Ion Pump ON
134
DM·16 ON
No
SMEAR
Yes
Record AM·03 (Microamps)

Figure 2.2-2 (e)

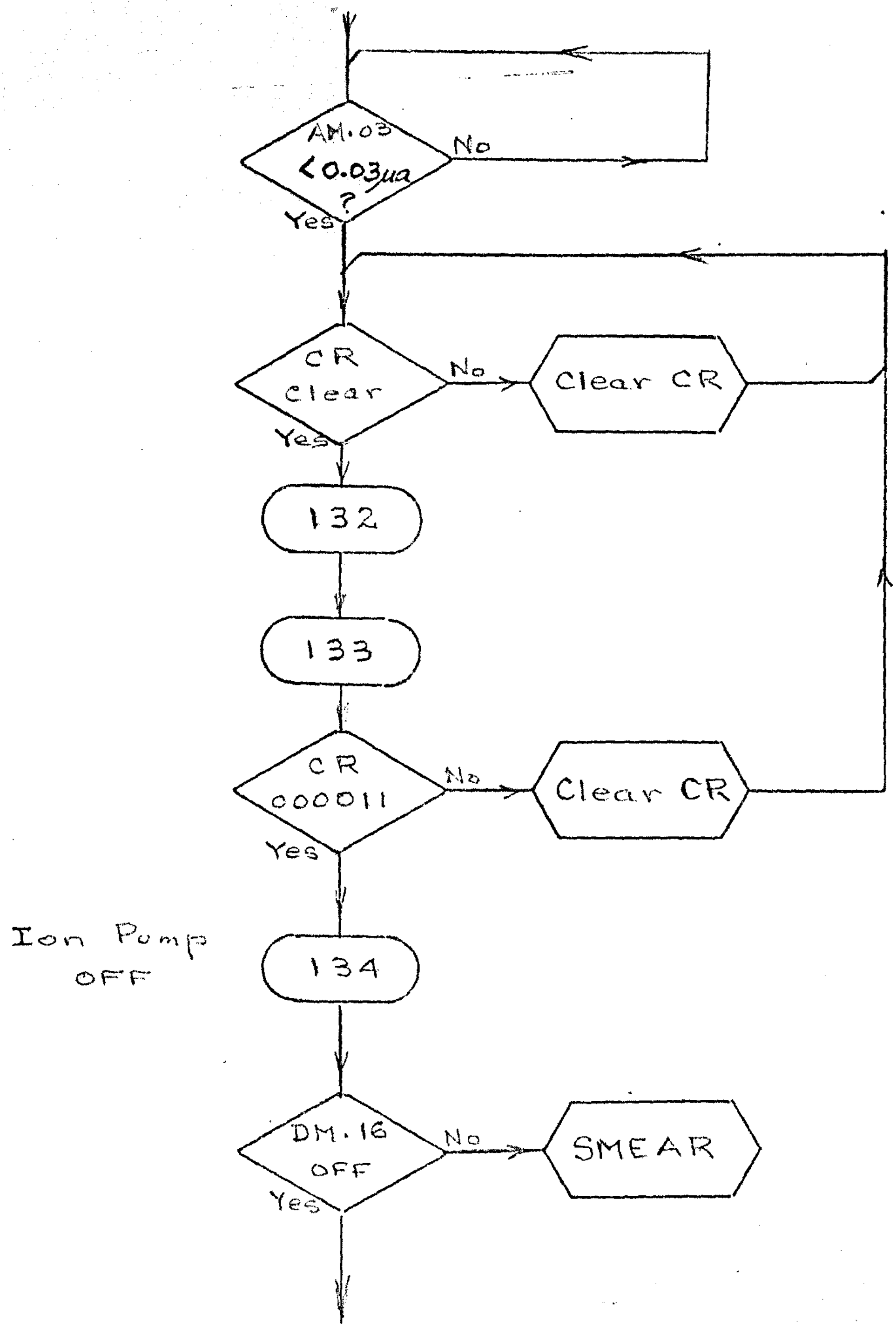

AM.03
< 0.03μa
?
No
Yes
CR
Clear
No
Clear CR
Yes
132
133
CR
000011
No
Clear CR
Yes
Ion Pump
OFF
134
DM.16
OFF
No
SMEAR
Yes

Figure 2.2-2 (f)

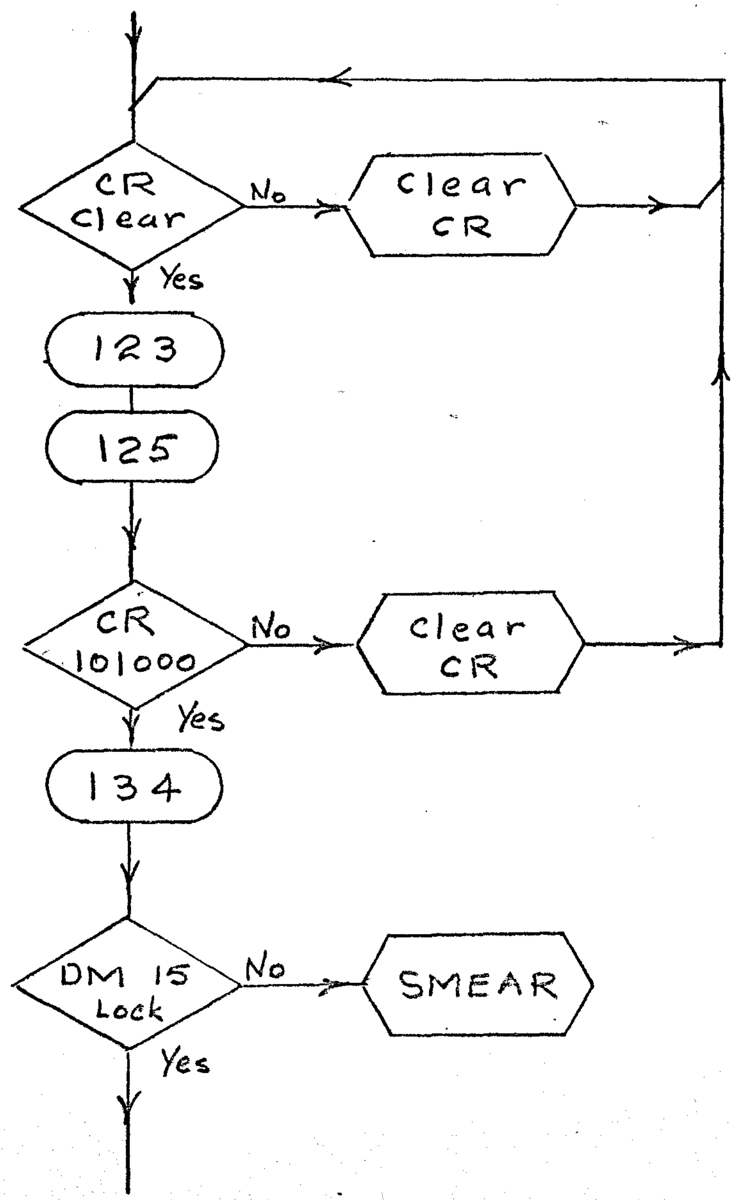

CR
Clear
No
Clear
CR
Yes
123
125
CR
101000
No
Clear
CR
Yes
134
DM 15
Lock
No
SMEAR
Yes

Figure 2.2-2 (g)

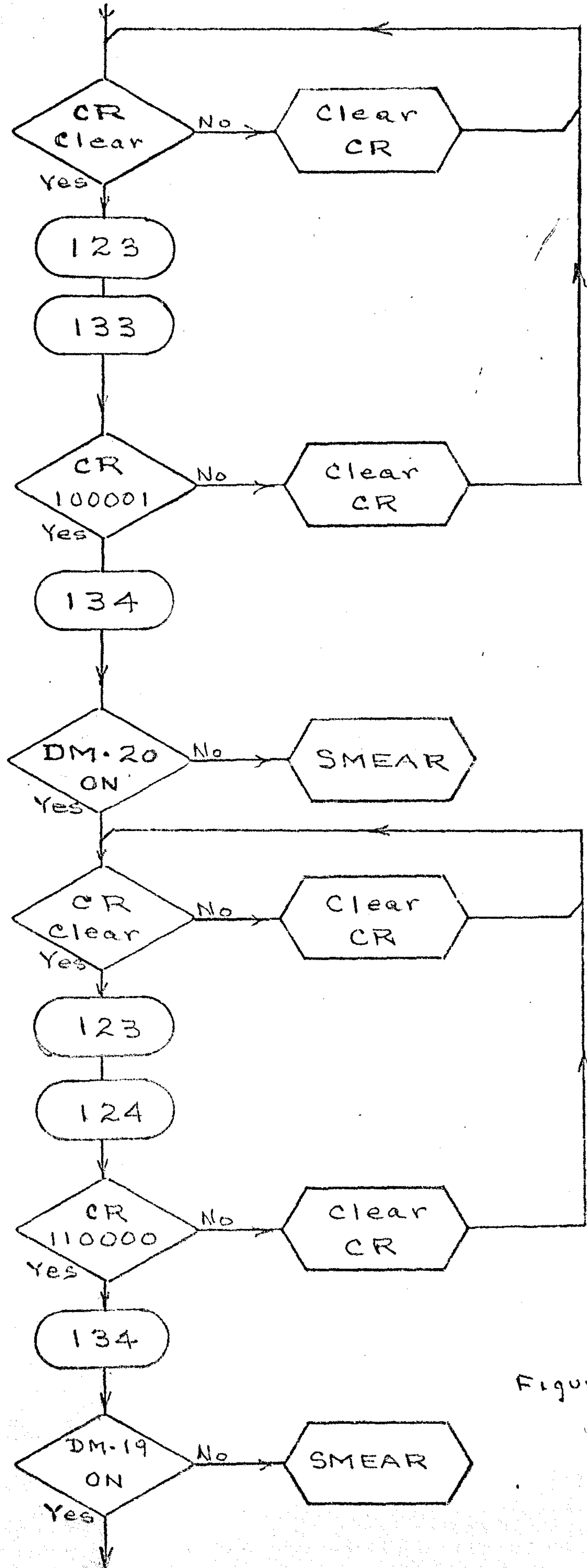

CR
Clear
No
Clear
CR
Yes
123
133
CR
100001
No
Clear
CR
Yes
134
DM·20
ON
No
SMEAR
Yes
CR
Clear
No
Clear
CR
Yes
123
124
CR
110000
No
Clear
CR
Yes
134
DM·19
ON
No
SMEAR
Yes

Figure 2.2-2 (h)

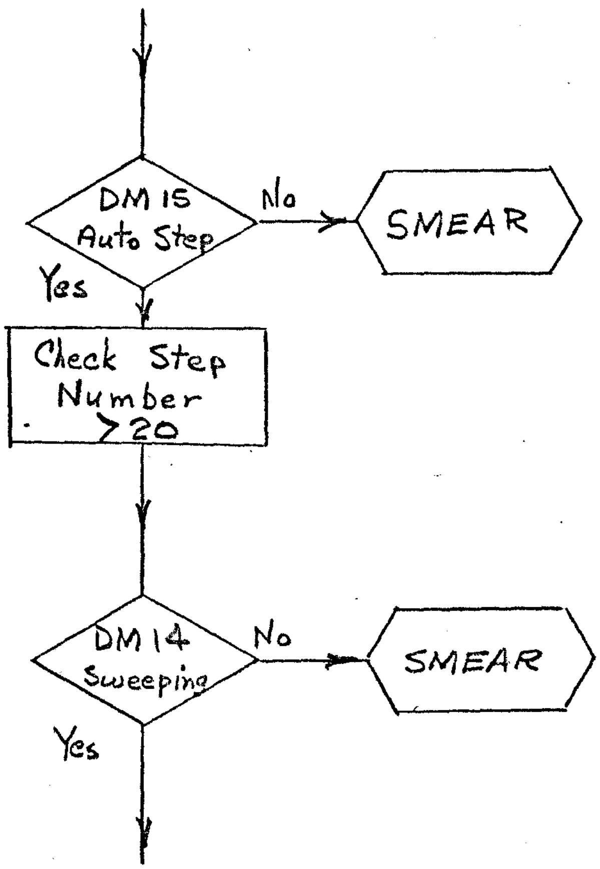

DM 15
Auto Step
No
SMEAR
Yes
Check Step
Number
>20
DM 14
Sweeping
No
SMEAR
Yes

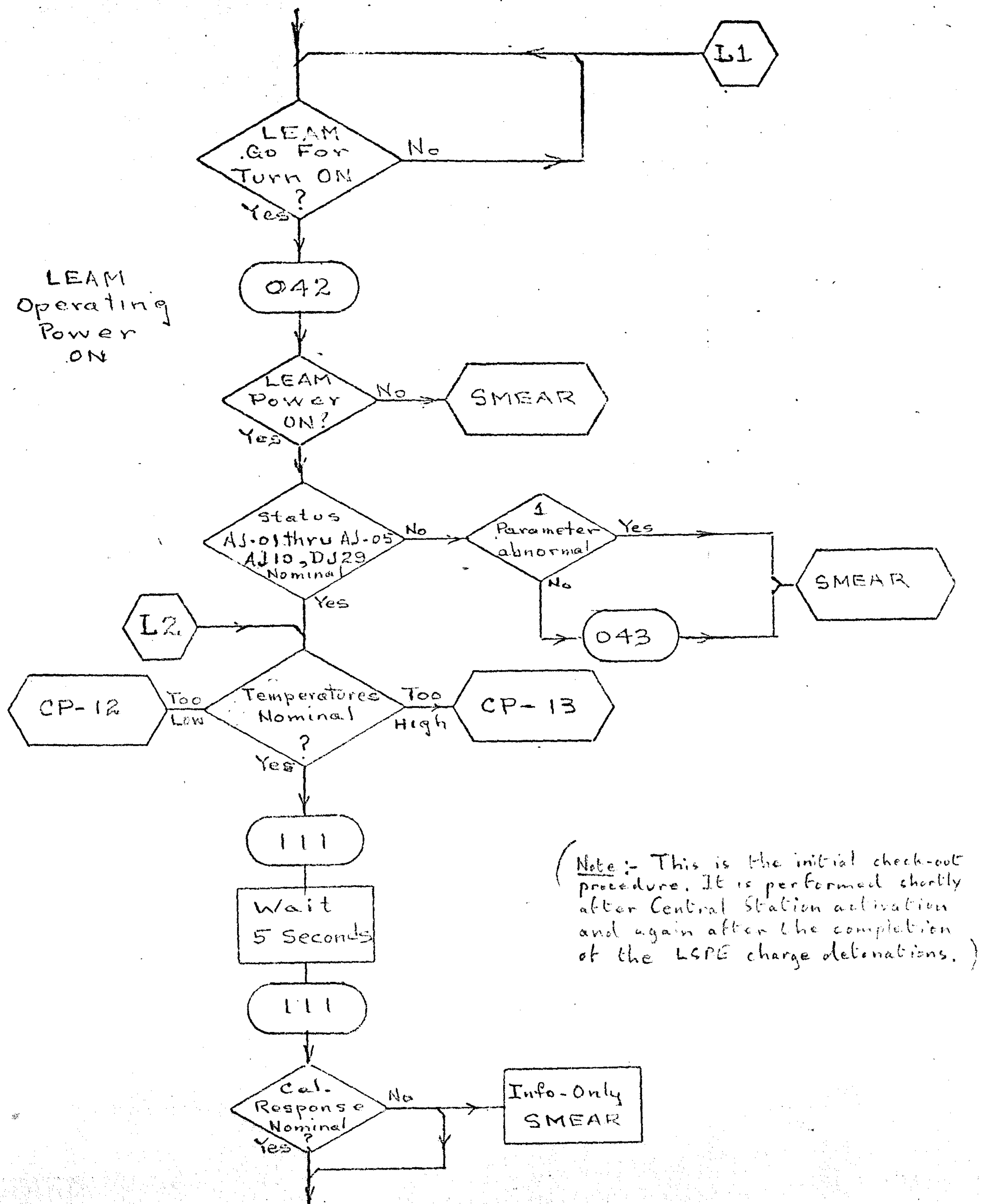
Figure 2.2-2 (i)

2.2.3 LEAM Initialization

The Lunar Ejecta and Meteorites instrument will be activated in the early hours of Array E operation to verify nominal engineering functioning.

A period of data collection of no less than 50 hours is required during which the instrument is operating with the sensor covers in place to obtain background data. The inherent risk of dust contamination of the LEAM thermal control mirror surfaces, during LM lift-off or LSP explosive package detonation, requires that the mirror dust cover remains in place until LSP operations are complete. As shown in Section 2.2 this is not until after lunar noon. There is a risk to the thermal integrity of the LEAM electronics if the instrument is operated through lunar noon with the mirror cover in place.

The initialization sequence presented in Figure 2.2-3 indicates that LEAM is turned OFF after the brief initial check-out until after conclusion of LSP explosive package operations, when the experiment is activated and the mirror cover released. LEAM operates in this mode until 2 days of lunar night environment have elapsed, at which time the sensor covers will be released allowing normal operation to begin.



(Note :- This is the initial check-out procedure. It is performed shortly after Central Station activation and again after the completion of the LSPE charge detonations.)

Figure 2.2-3 (a) LEAM Initialization

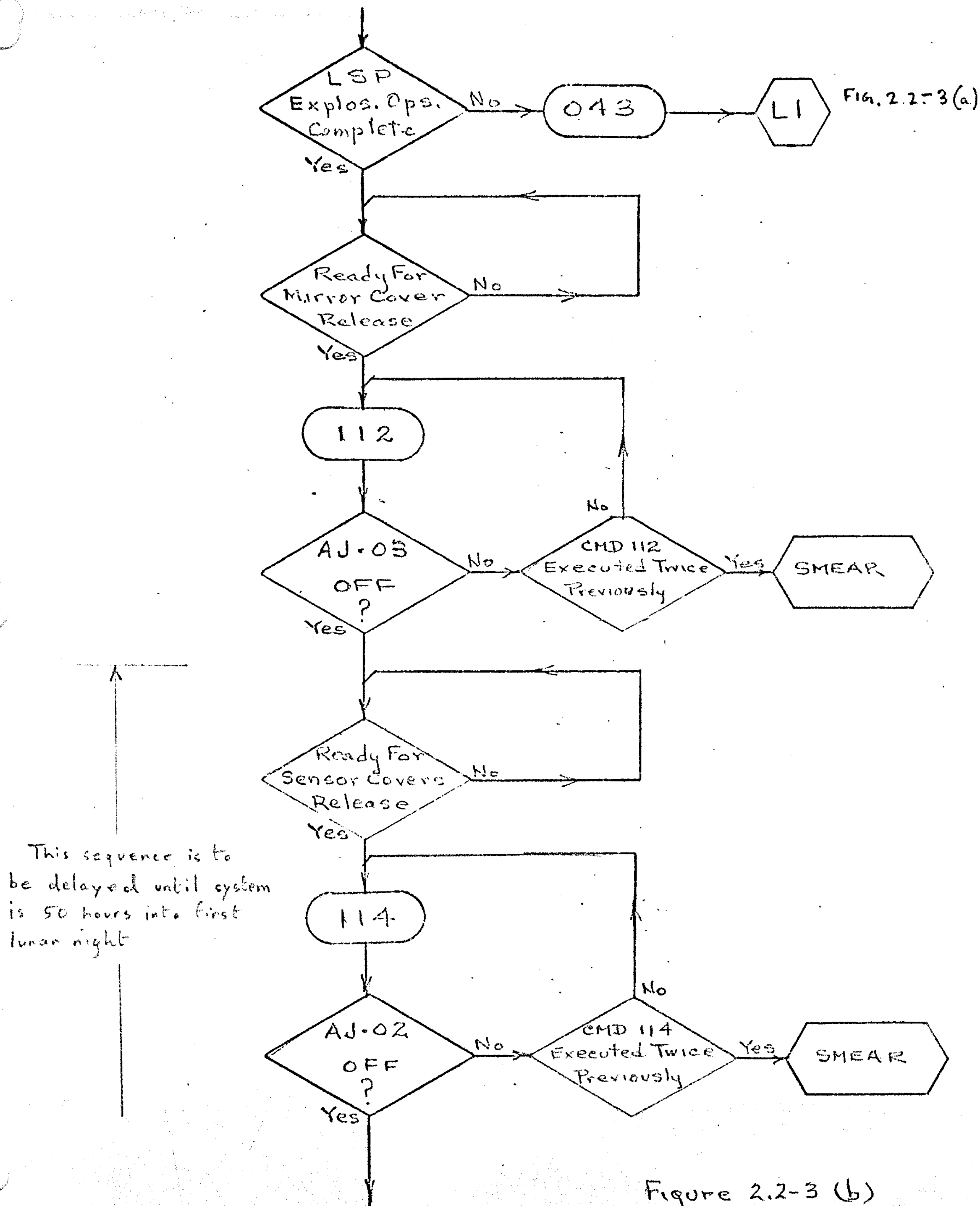

LSP Explos. Ops. Complete
No
043
L1
FIG. 2.2-3 (a).
Yes
Ready For Mirror Cover Release
No
Yes
112
AJ-03 OFF ?
No
CMD 112 Executed Twice Previously
No
Yes
SMEAR
Yes
Ready For Sensor Covers Release
No
Yes
114
AJ-02 OFF ?
No
CMD 114 Executed Twice Previously
No
Yes
SMEAR
Yes
This sequence is to be delayed until system is 50 hours into first lunar night

Figure 2.2-3 (b)

2.2.4 HFE Initialization

HFE should be activated, following sequence in Figure 2.2-4 (a), as soon as the first HFE probe has been emplaced by the crew. A full 7 - minute sequence print-out should be obtained as soon as possible in order that satisfactory operation can be verified. (In the event that difficulties are encountered in drilling two acceptable HFE probe holes, the information as to the status of the one probe that is emplaced may be important in determining the contingency action to be taken.) It is important to ensure that the instrument is operating in the normal mode and that the heater excitation state is OFF. HFE data should be recorded in hard copy at least once every two hours throughout the first week of operation (exclusive of LSPE operational periods) so that adequate data is available to monitor the equalization of temperatures following the drilling operations.

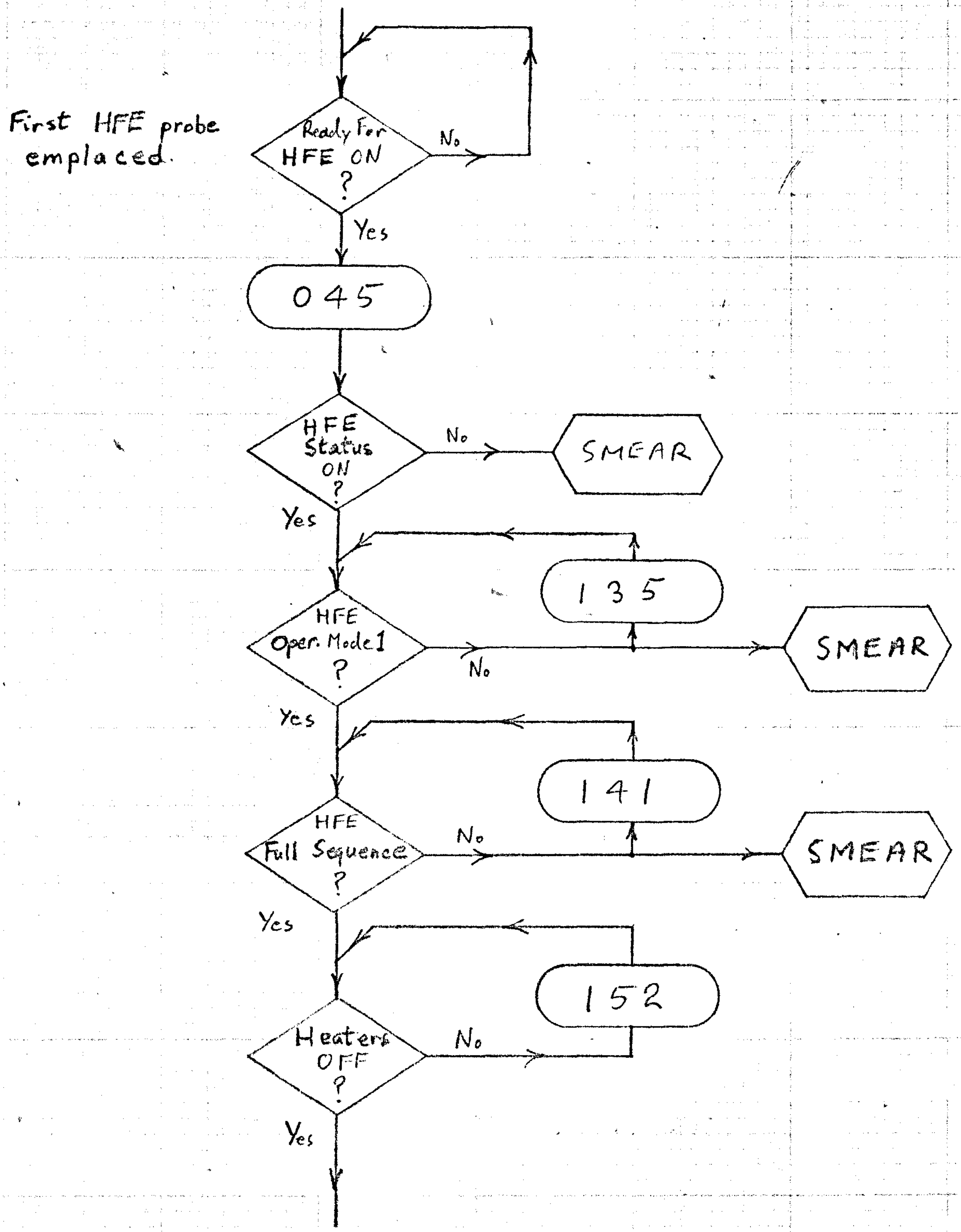


Figure 2.2-4(a) HFE Initialization.

2.2.5 LSG Initialization

The Lunar Surface Gravimeter will be activated during the first few hours of Array E operation to check for nominal engineering status.

Initial operations in "setting-up" the LSG will be directed toward three objectives:

A. Centering the seismic sensor in its measurement range, through

- mass selection

- coarse and fine beam adjustments (each of which have two commandable rates)

Two mass increments are provided each of which, when added or removed, will produce a change in seismic output (DG-01) equivalent to 700 times the total seismic scale range. Lesser adjustments are made by command, to the extent required, in accordance with the four slewing rates selectable, as follows:

	Effect of Each Commanded Increment (% of total seismic scale) [1]	
	Gross Increment (CR = 15 or 16)	Vernier Increment (CR = 17 or 18)
Coarse Screw (CR =11)	2330	18.2
Fine Screw (CR = 19)	17.6	0.137

B. Aligning the sensor with the gravity vector by tilting the sensor on the gimbal by shifting its center of mass using the "tilt" motors.

1. Applies for PA gain step @ 3 i.e, PA gain of 12.

C. Adjusting the control point of the sensor temperature until the seismic sensor is operating at a condition of minimum temperature sensitivity.

Figures 2.2-5 and 2.2-6 present in flow-chart format the command sequences required to implement this initialization. These procedures assume the LSG is in the configuration shown in Table 2.2-5 when power is first turned on. The flow charts make use of the following abbreviations when referring to the LSG octal command signals:

COMMAND	ABBREV.	ALSEP COMMAND NO.
LSG COMMAND DECODER ON	CDØN	070
LSG COMMAND DECODER OFF	CDØFF	071
COUNT UP	INC	072
COUNT DOWN	DEC	074
EXECUTE COMMAND	EX	067
SLAVE HEATER ON	SHØN	063
SLAVE HEATER OFF	SHØFF	064

Multiple transmissions of the same command will be indicated by N (the number of commands) following the abbreviation. The actual command number is given at the right.

EXAMPLE: | EX/7 | 067 |

This would mean that the EXECUTE command is to be transmitted seven times in succession with at least 2 seconds delay between transmissions.

In order to simplify the description of the general procedures, certain repetitive procedures or sub-routines have been identified. These procedures are presented in Figure 2.2-5 (a) through 2.2-5 (i). The LSG initialization procedure is presented in Figure 2.2-6.

TABLE 2.2-5

LSG INITIAL CONFIGURATION

LSG Function	Initial Status
Coarse Slew Adjustment	At Upper Limit
Fine Slew Adjustment	At Mid-Scale
Temperature Control	At Optimum Earth Setting
Tilt Adjustment	At Optimum Earth Setting

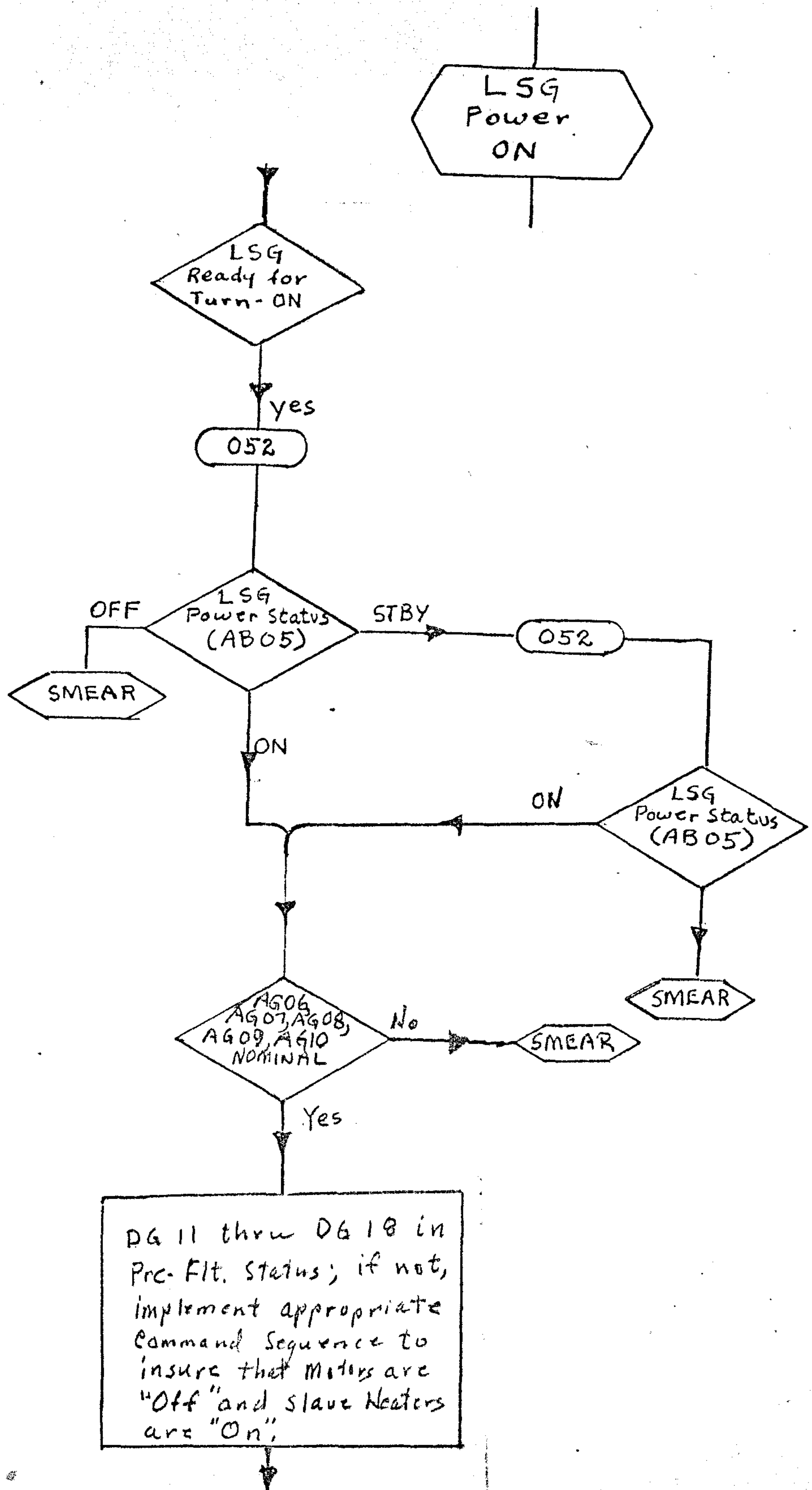
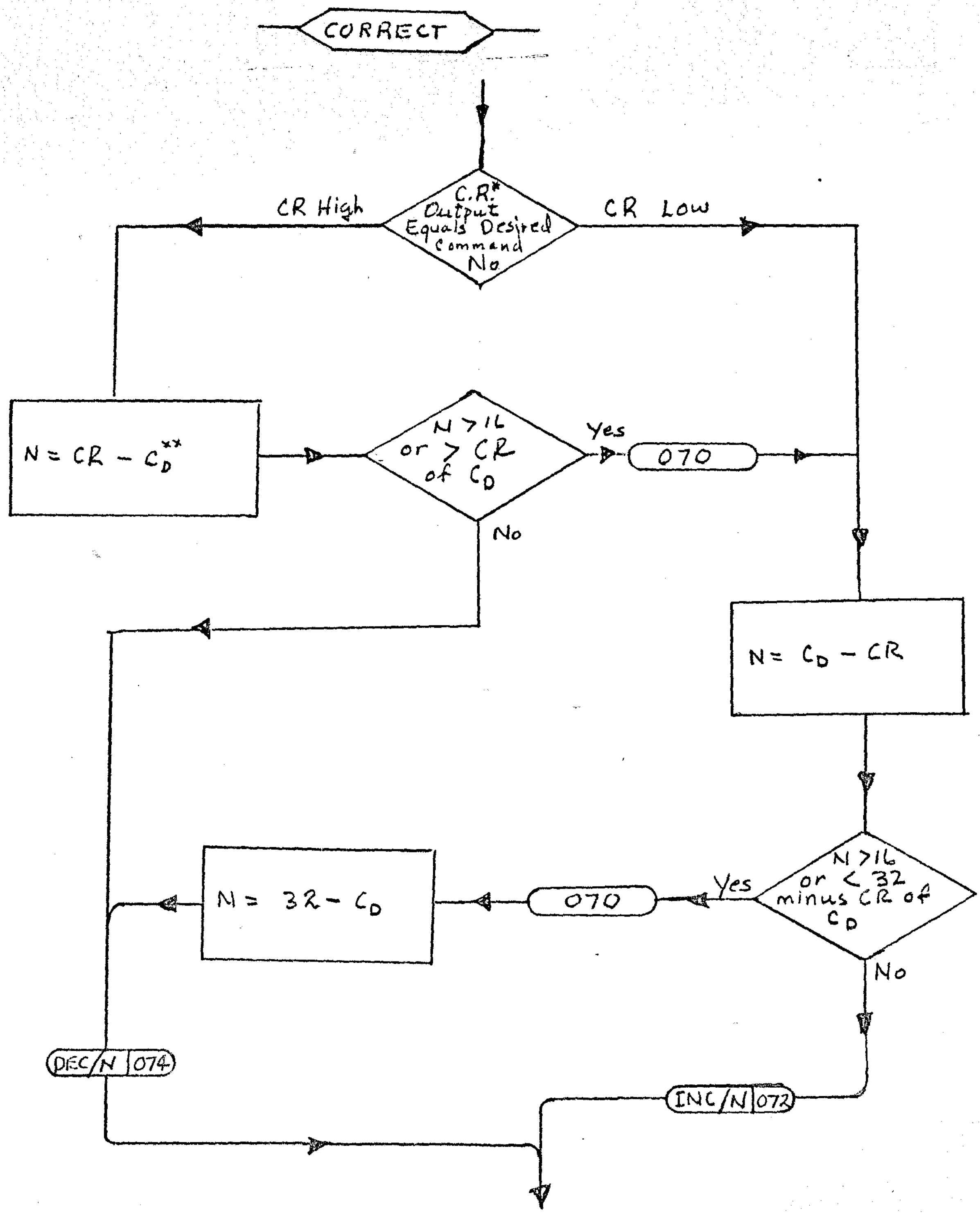


Figure 2.2-5(a) LSG Power ON



* CR = Command Register Indication

** C_D = Desired LSG Command

Figure 2.2–5 (b) Procedure, Setting LSG Command Register

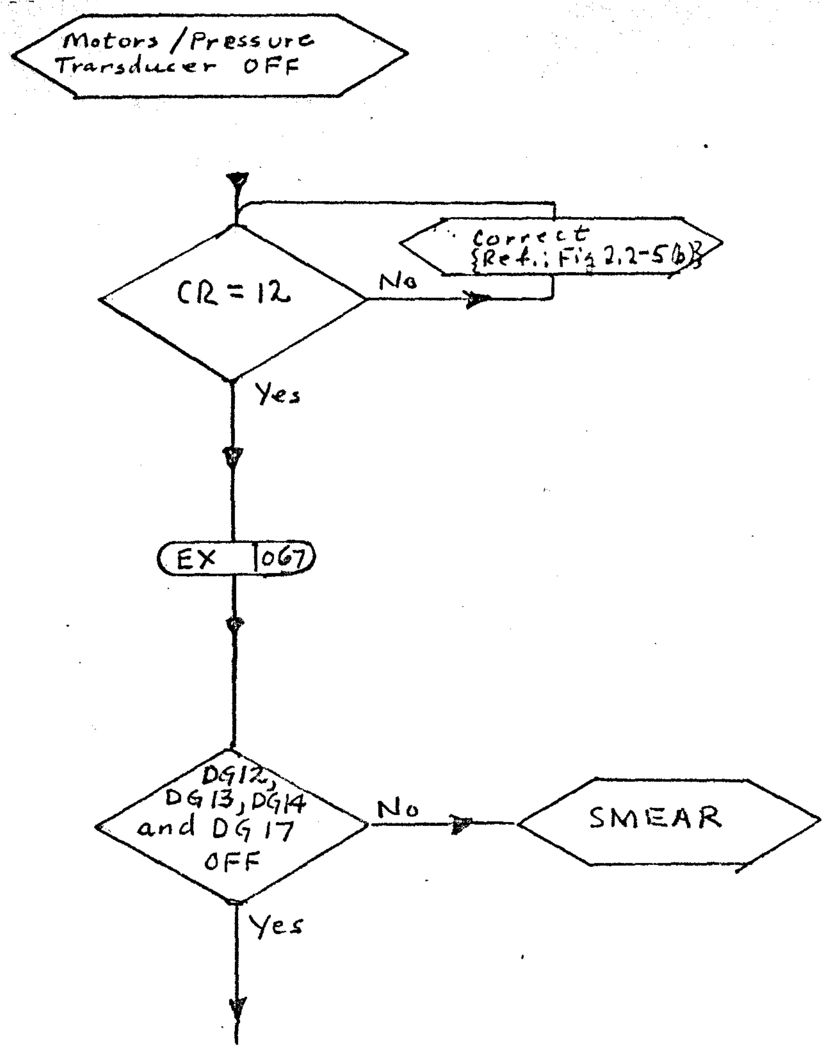


Figure 2.2-5 (c) Motors/Pressure Transducer Off Procedure

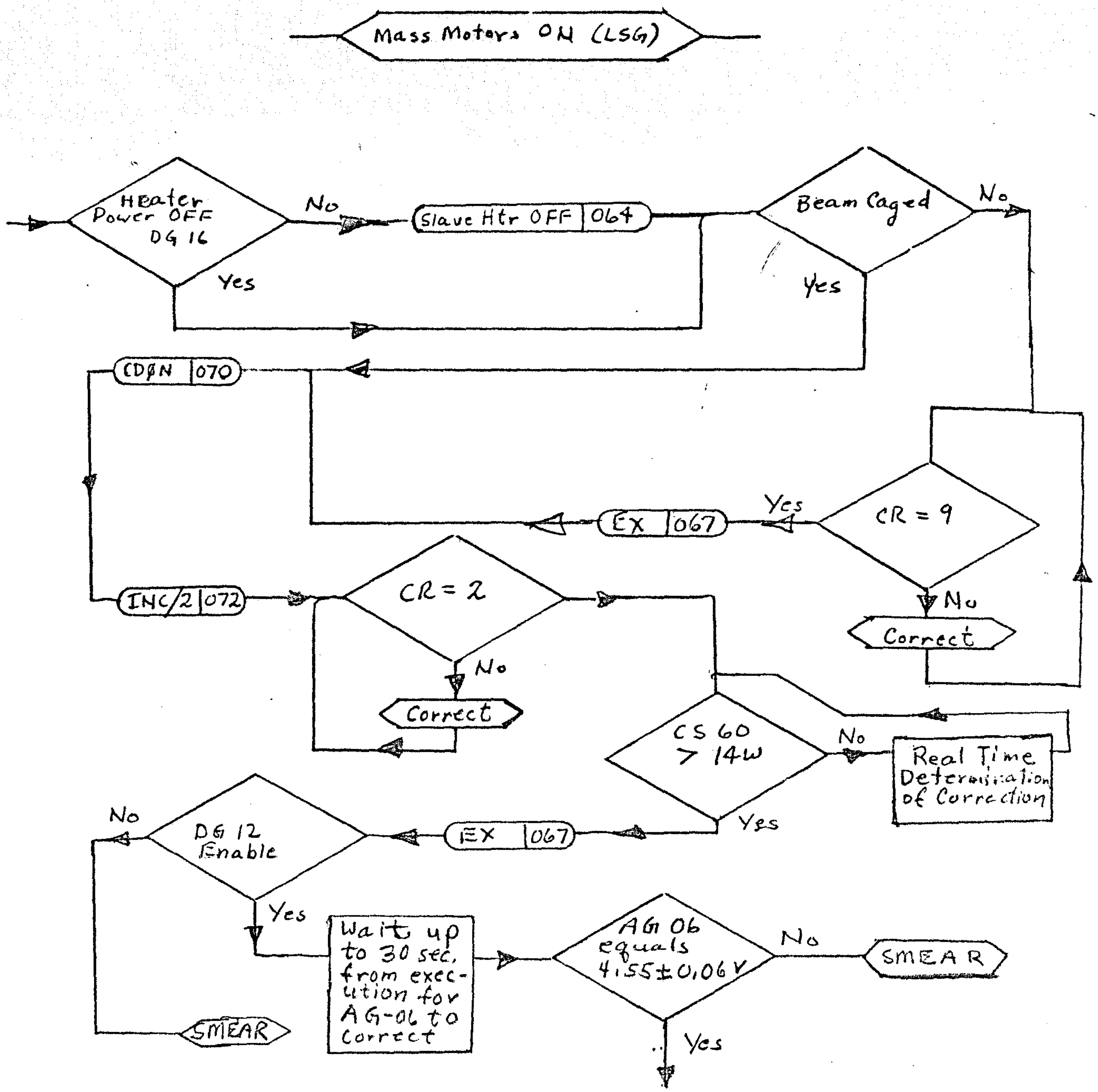
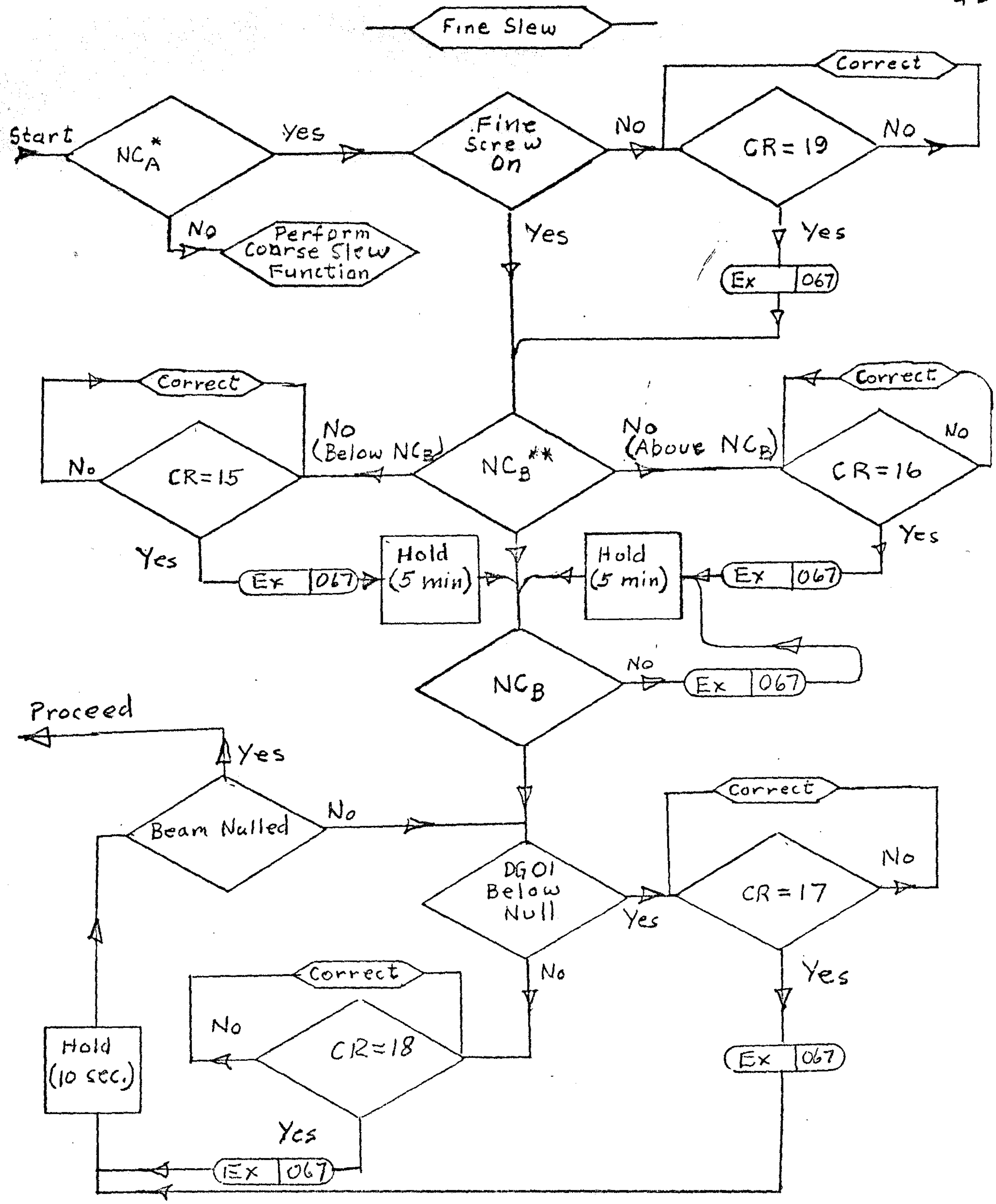


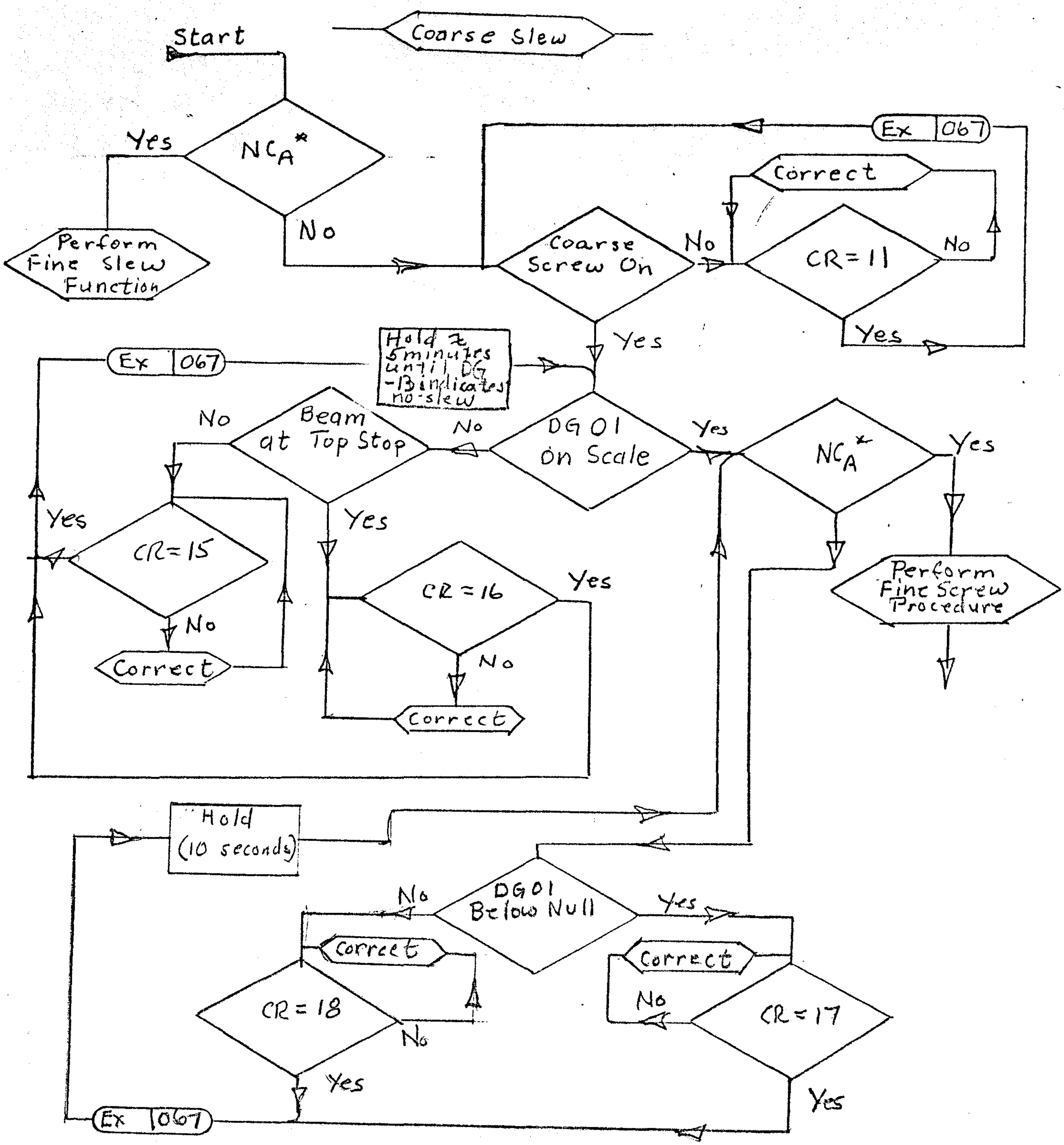
Figure 2.2-5 (d) "Mass Motor ON" Procedure (LSG)



* Null Condition A - DG-01 at center scale (±20% of full scale); PA Gain at 3rd Step (Gain = 12)

** Null Condition B - DG-01 at center scale (±2% of full scale); PA Gain at 3rd Step (Gain = 12)

Figure 2.2-5(e) "Fine Slew" Procedure



* NC_A = Null Condition A with DG 01 at center scale (± 20% FS); PA Gain at step 3 (Gain = 12)

Figure 2.2-5 (f) - "Coarse Slew" Function

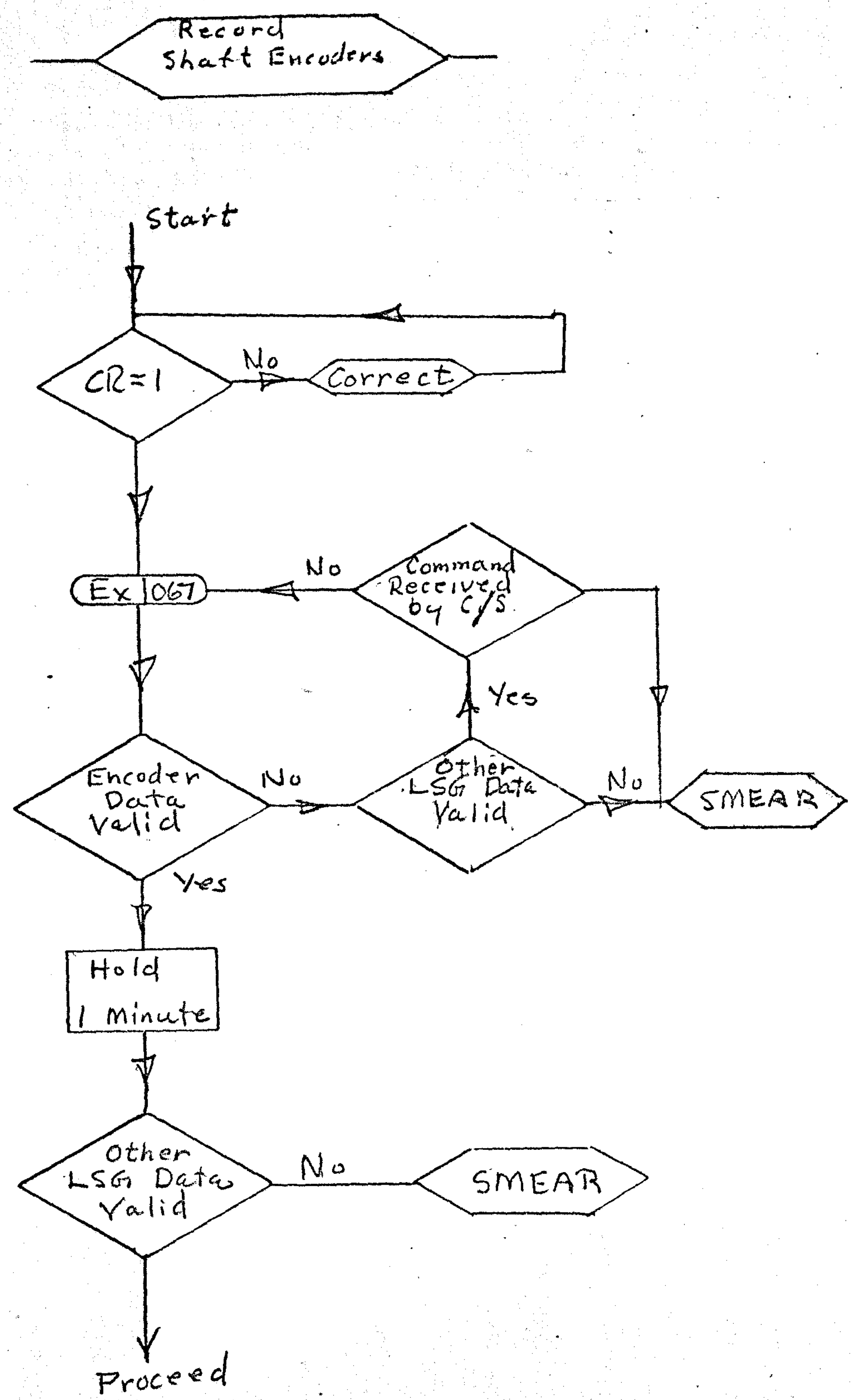
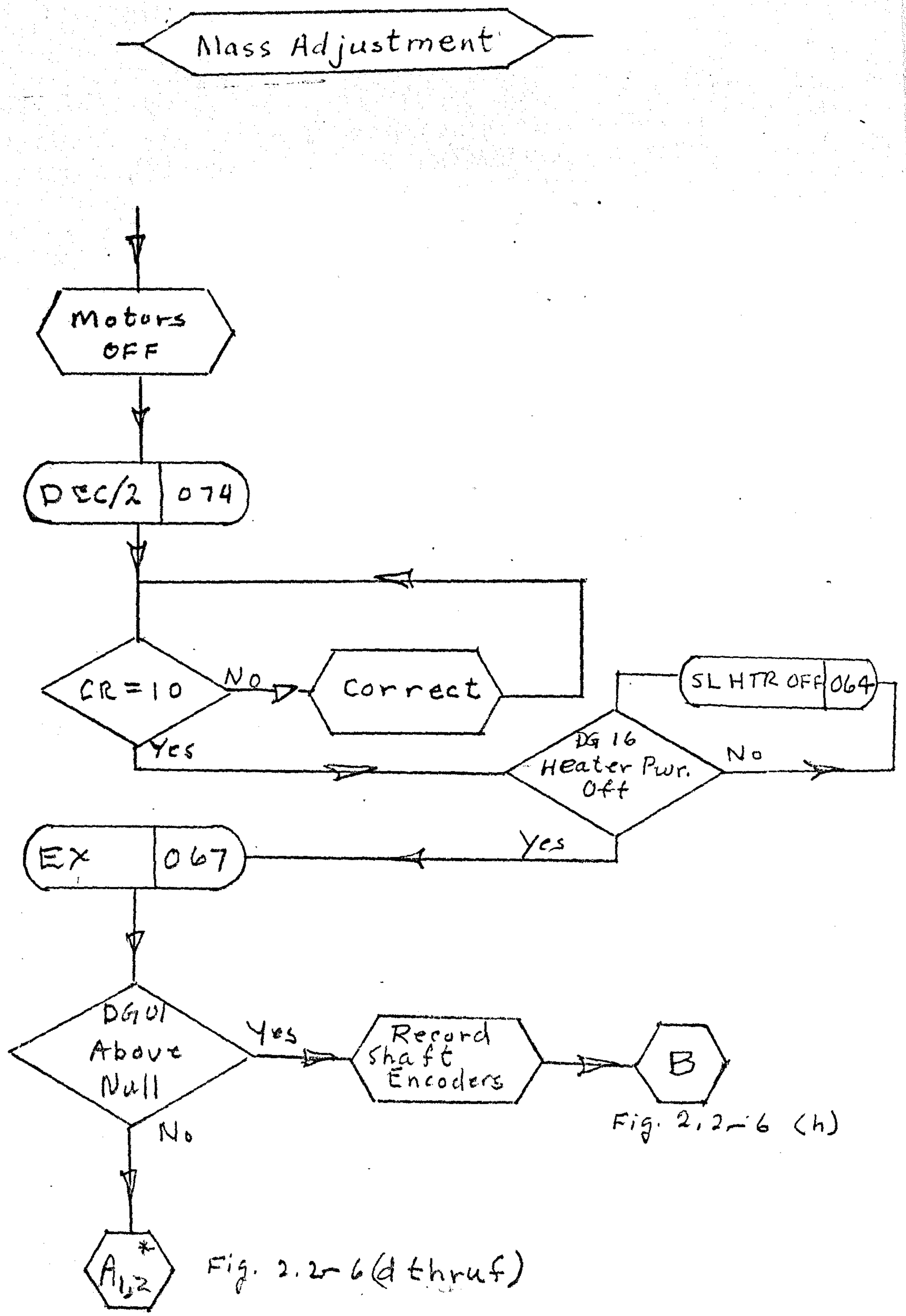


Figure 2.2-5 (g) "Encoder Data" Procedure



* Perform A_1 the first time through this procedure and if required, perform A_2 the second time through.

Figure 2.2-5 (h) "Mass Adjustment" Procedure (LSG)

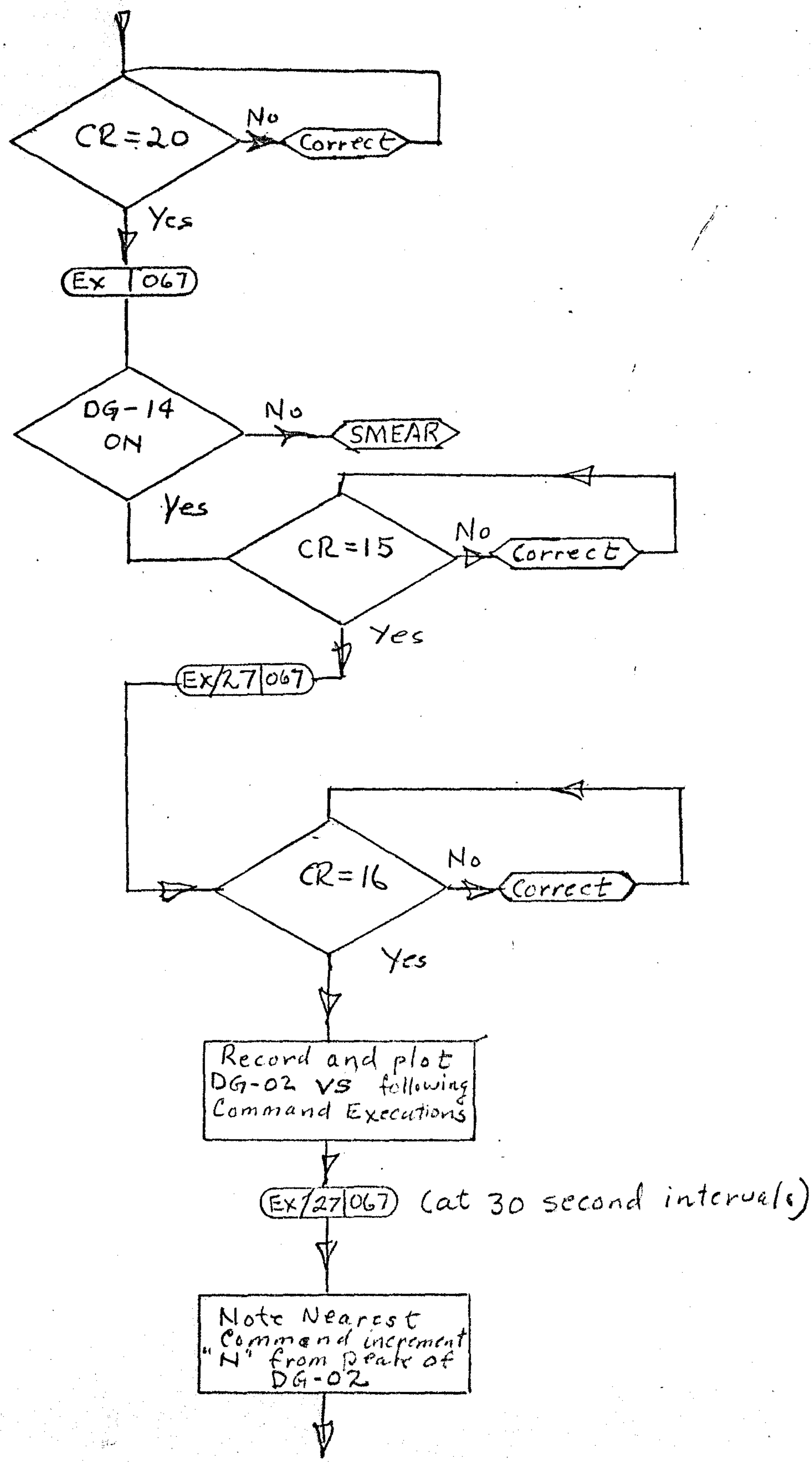


Figure 2.2-5 (i) Tilt Sensitivity-Adjust (N/S)

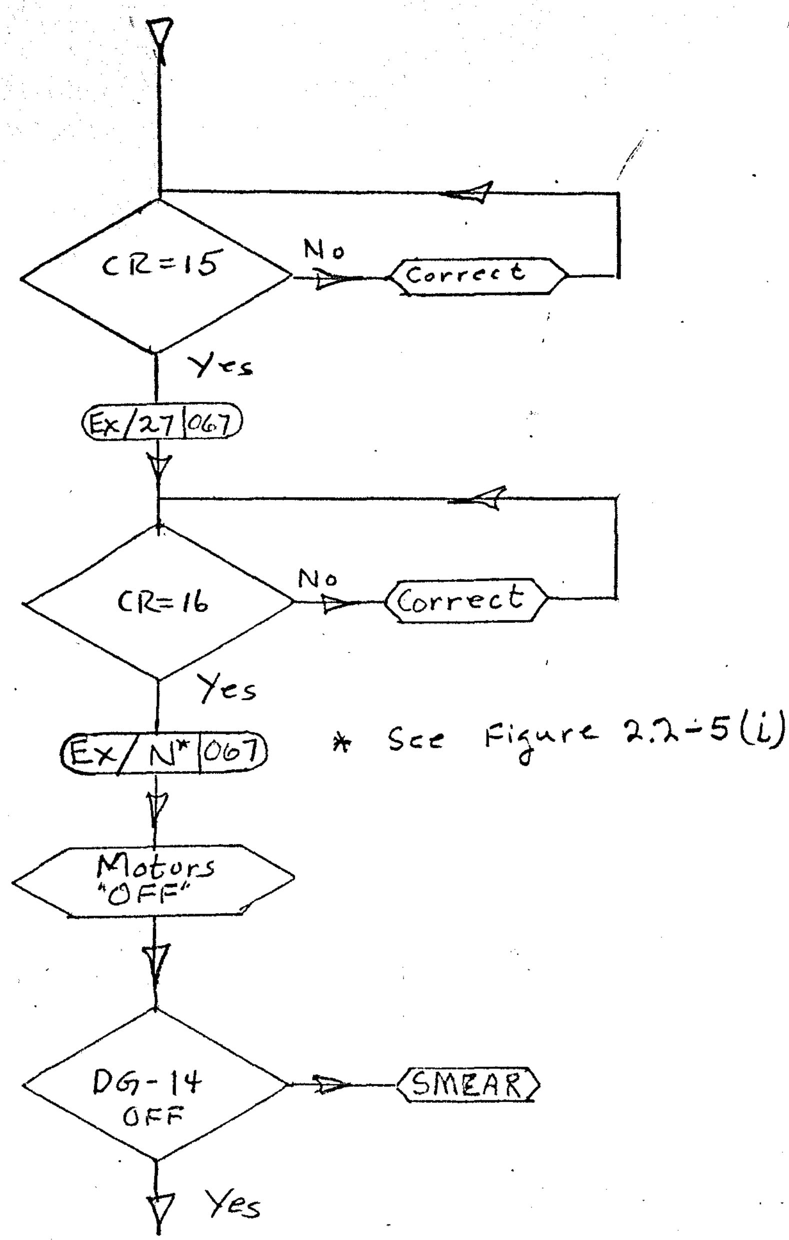

CR=15
No
Correct
Yes
Ex/27|067
CR=16
No
Correct
Yes
Ex/N*|067
* See Figure 2.2-5(i)
Motors
"OFF"
DG-14
OFF
SMEAR
Yes

Figure 2.2-5 (j)

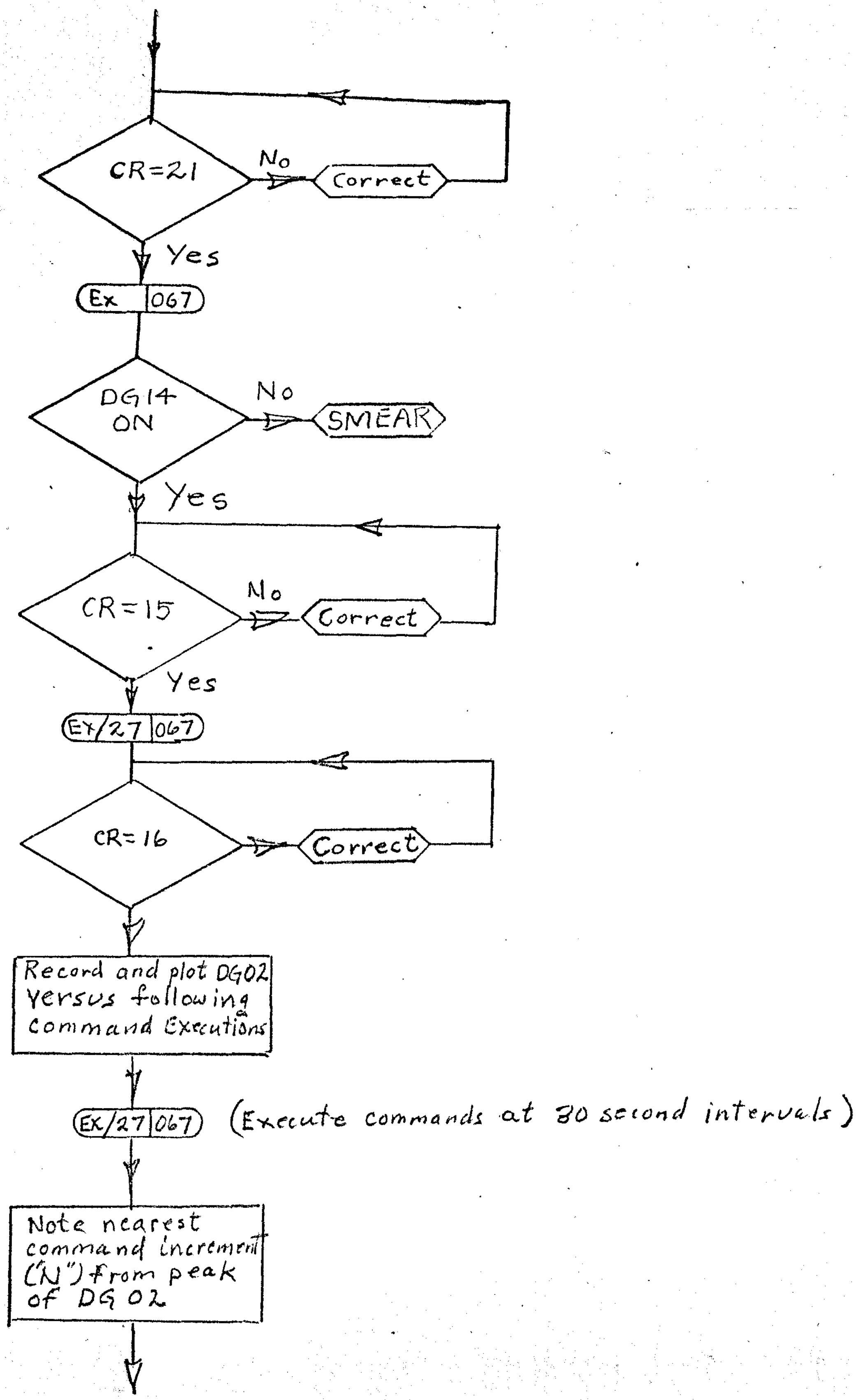
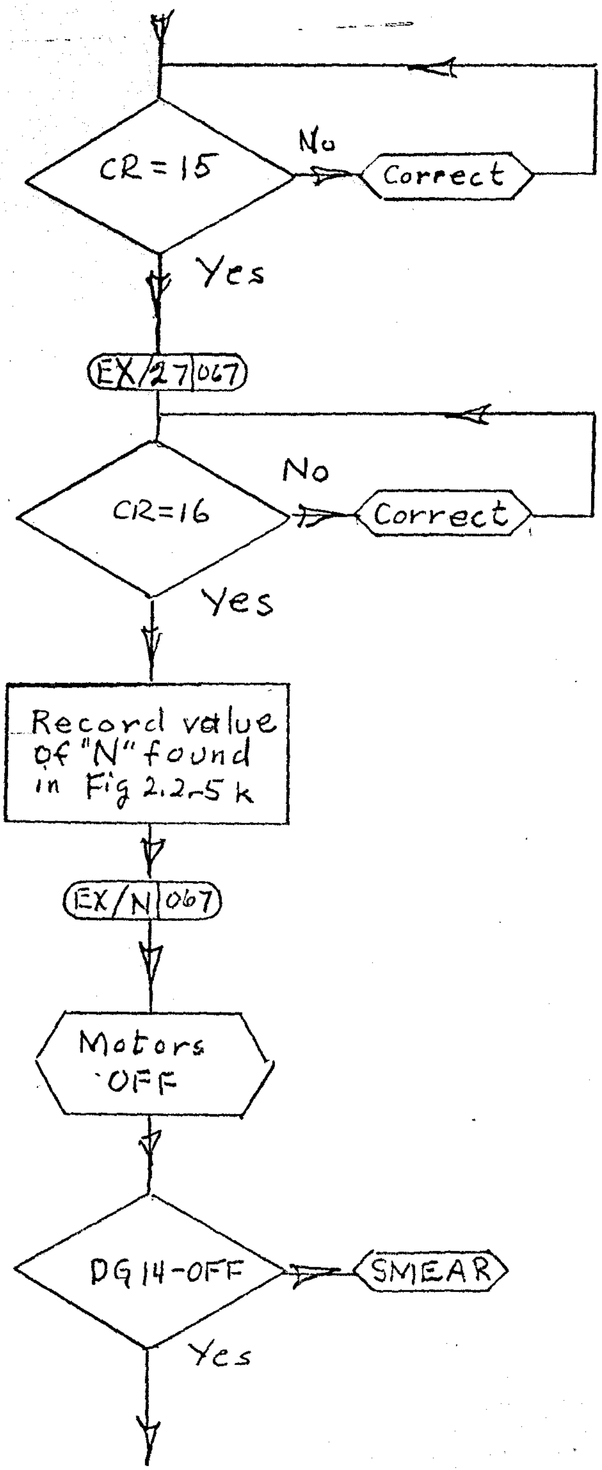


Figure 2.2-5(k) Tilt Sensitivity - Adjust (E/W)



N = increment calculated on Figure 2.2-5(k)

Figure 2.2-5 (l)

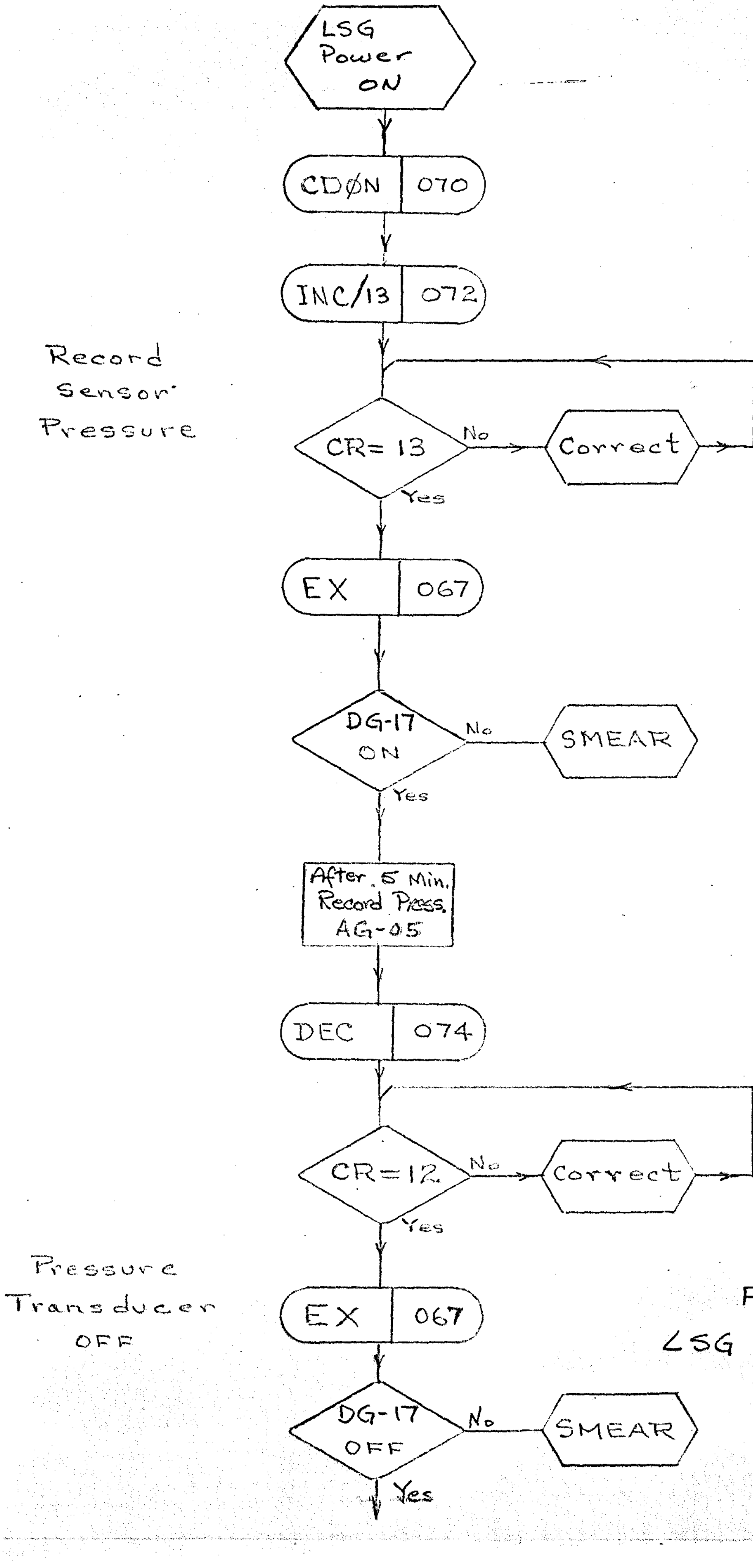


Figure 2.2-6(a)
LSG Initiallyation Sequence

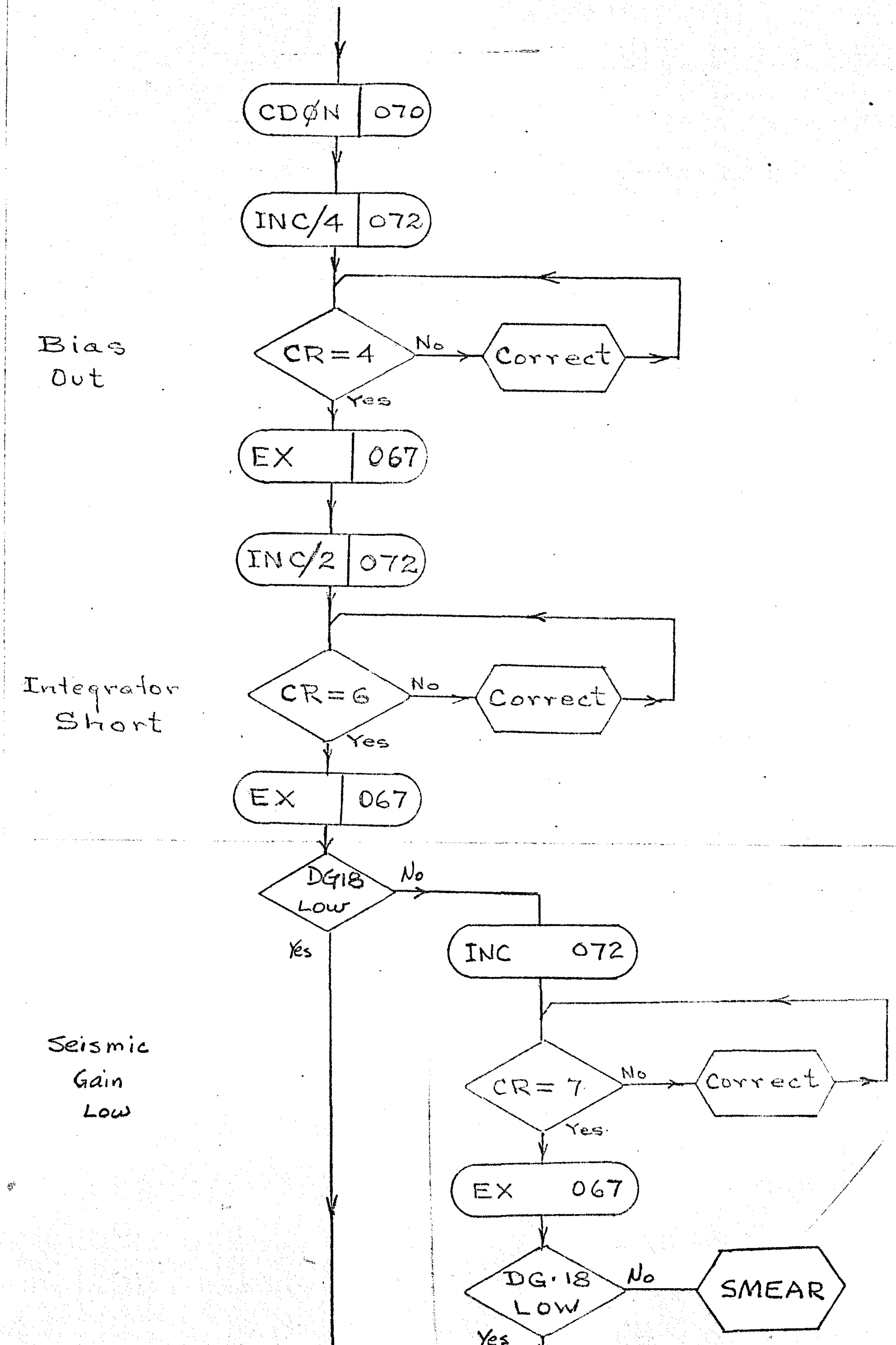

CDØN 070
INC/4 072
Bias Out
CR=4
No
Yes
Correct
EX 067
INC/2 072
Integrator Short
CR=6
No
Yes
Correct
EX 067
DG18 Low
No
Yes
INC 072
Seismic Gain Low
CR= 7
No
Yes
Correct
EX 067
DG·18 Low
No
Yes
SMEAR

Figure 2.2-6 (b)

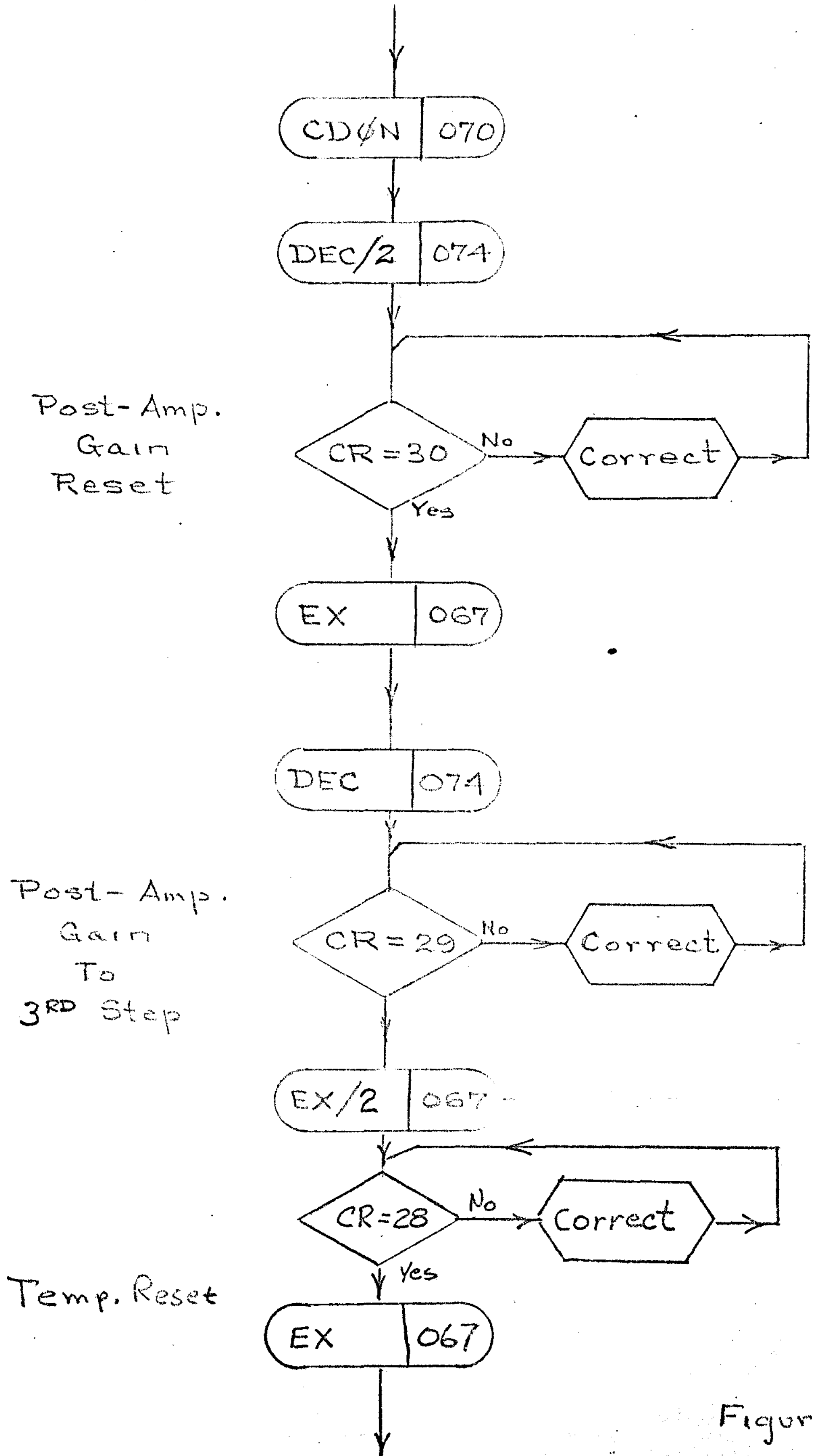
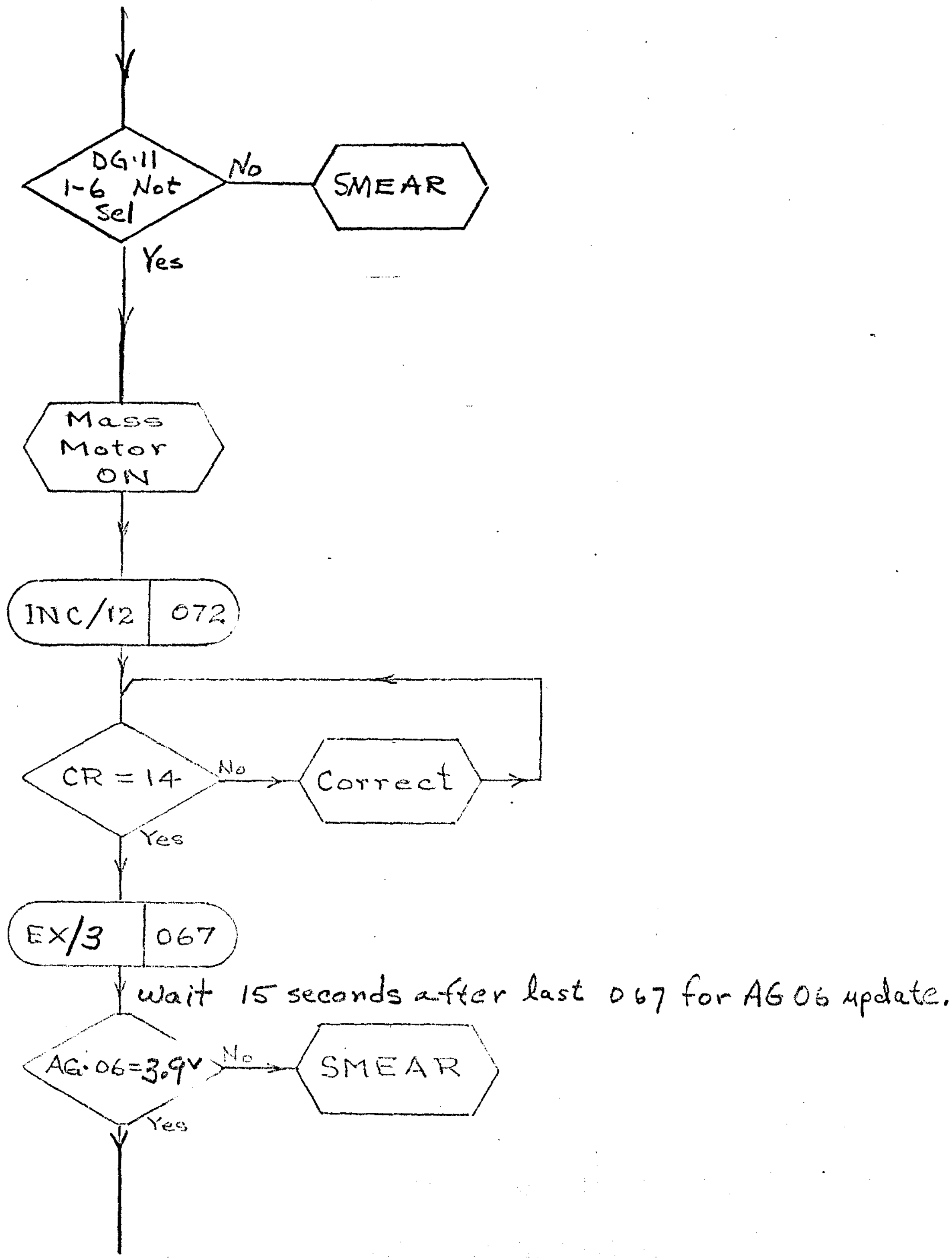

CDØN
070
DEC/2
074
Post-Amp.
Gain
Reset
CR=30
No
Correct
Yes
EX
067
DEC
074
Post-Amp.
Gain
To
3RD Step
CR=29
No
Correct
EX/2
067
CR=28
No
Correct
Yes
Temp. Reset
EX
067

Figure 2.2-6 (C)



All Masses On with Backlash Corrected

Figure 2.2-6 (d)

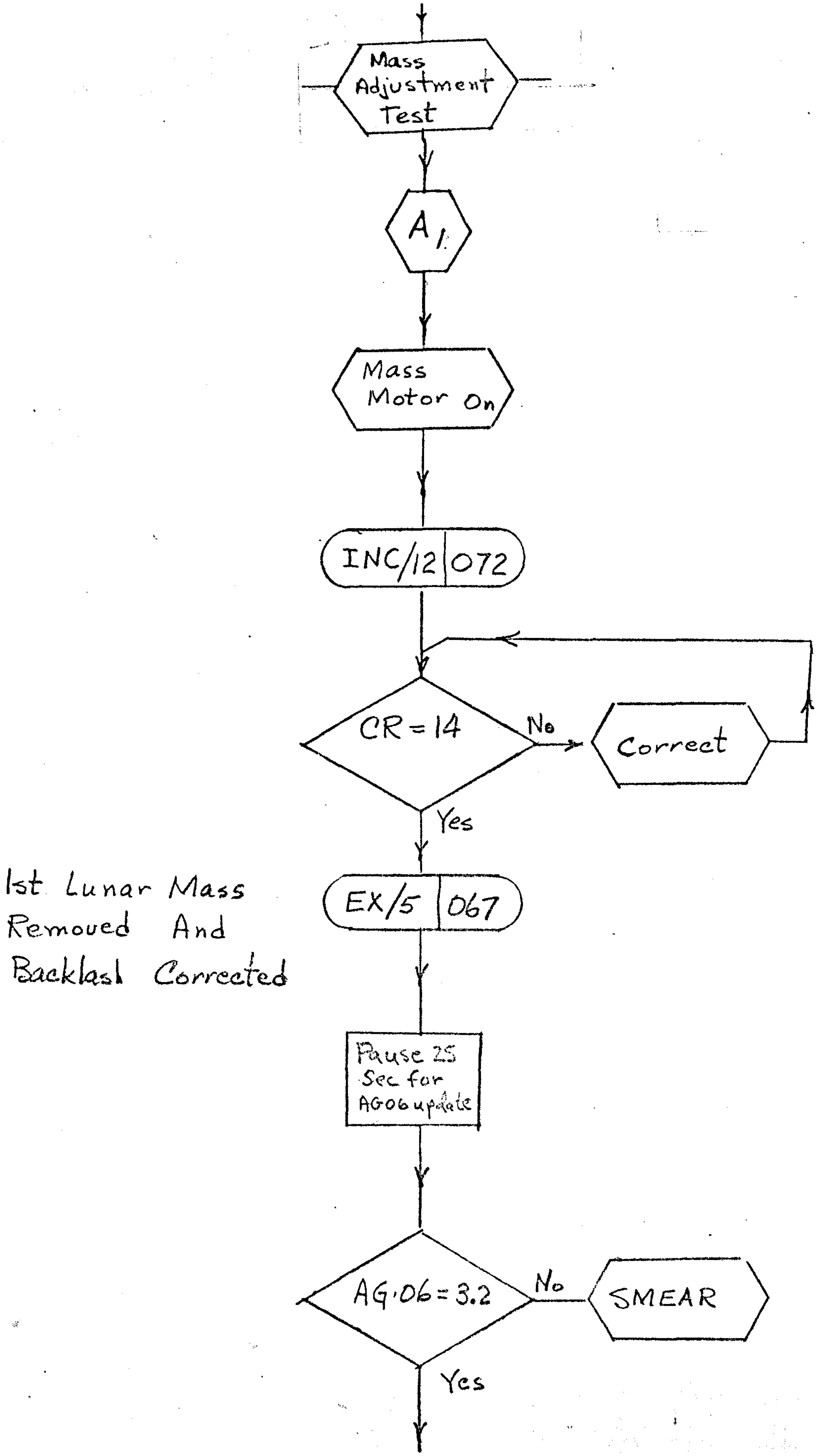
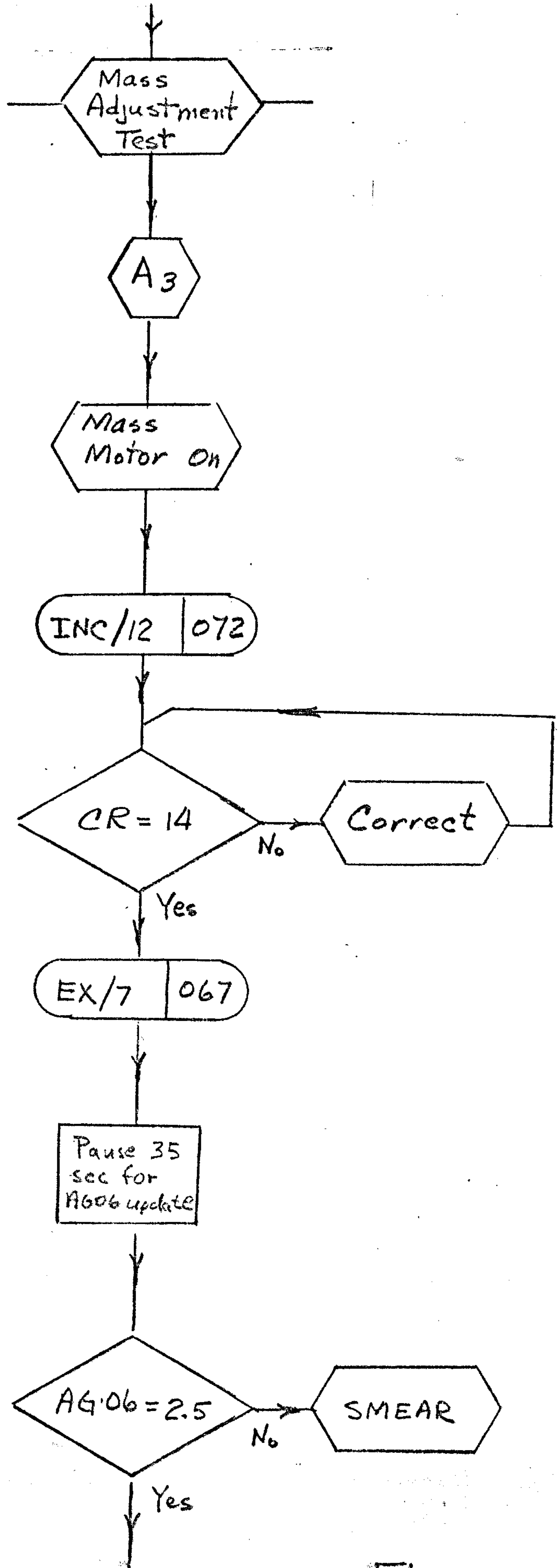

Mass
Adjustment
Test
A1
Mass
Motor On
INC/12 | 072
CR = 14
No
Correct
Yes
1st Lunar Mass
Removed And
Backlash Corrected
EX/5 | 067
Pause 25
Sec for
AG06 update
AG.06 = 3.2
No
SMEAR
Yes

Figure 2.2-6 (e)



2nd Lunar Mass Removed And Backlash Corrected

Figure 2.2-6 (f)

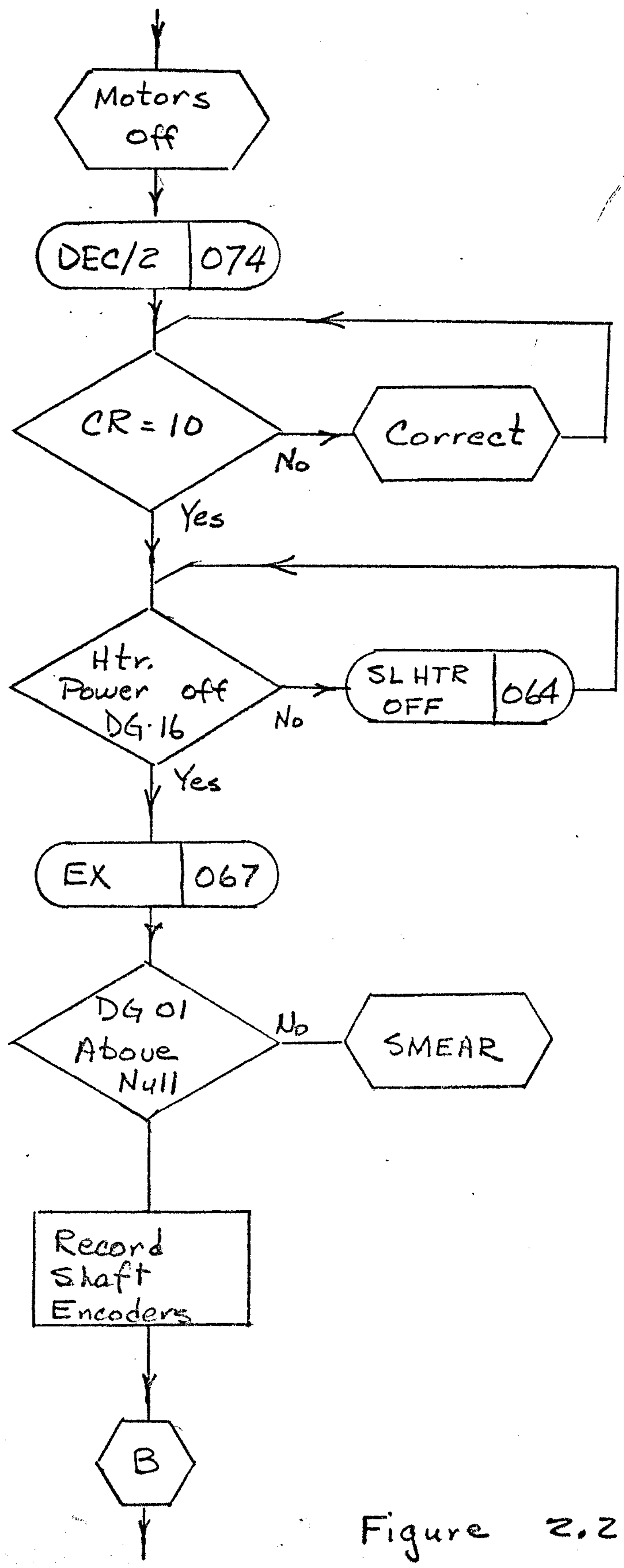

Motors off
DEC/2
074
CR = 10
No
Correct
Yes
Htr. Power off DG·16
No
SL HTR OFF
064
Yes
EX
067
DG 01 Above Null
No
SMEAR
Record Shaft Encoders
B

Figure 2.2-6 (g)

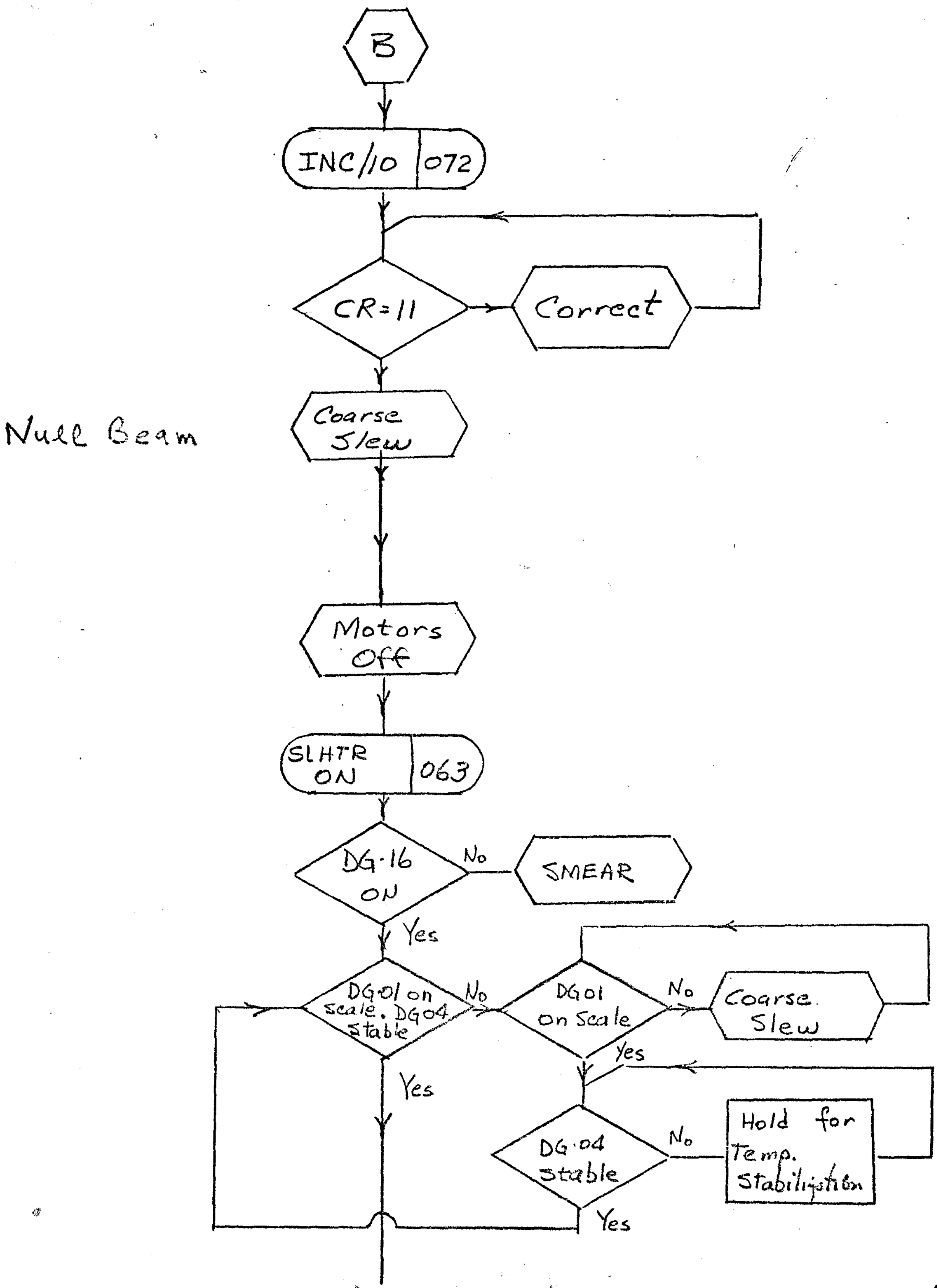
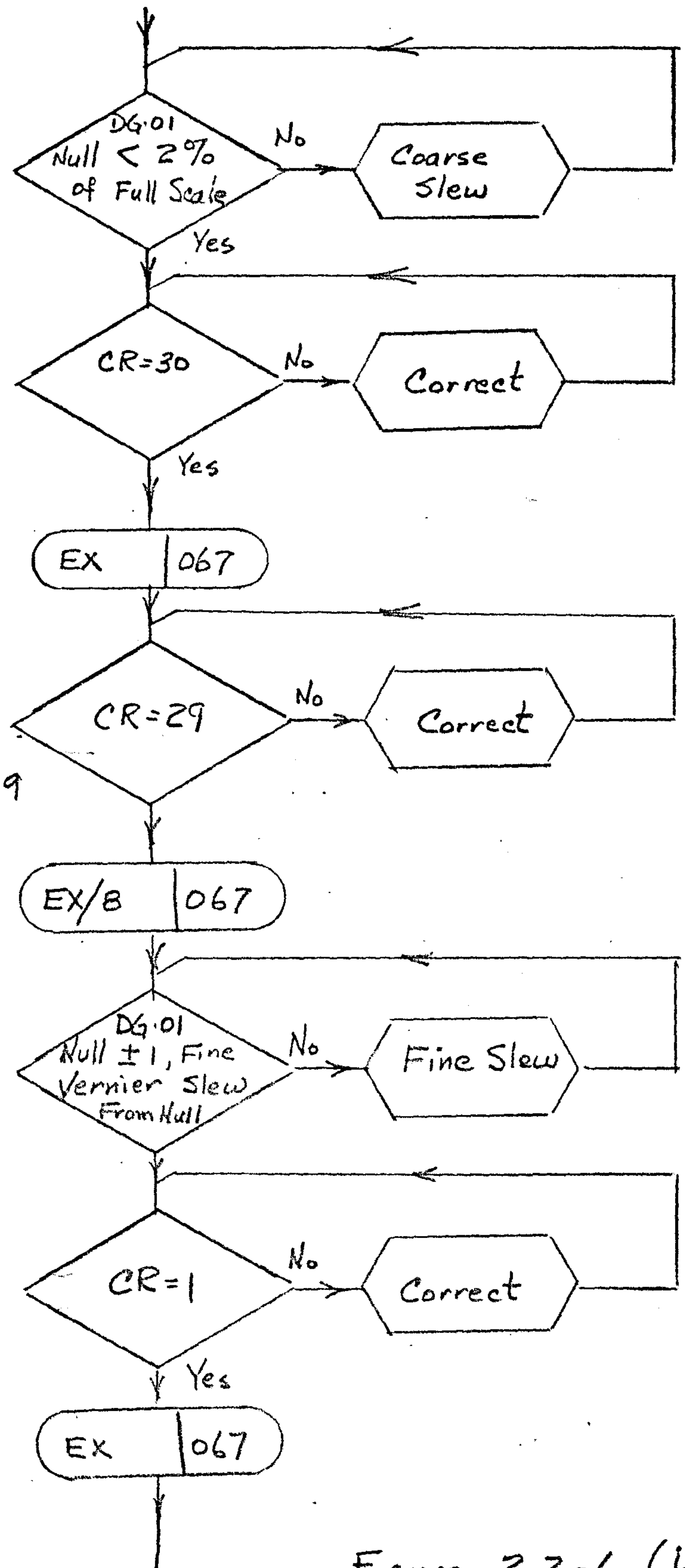

B
INC/10
072
CR=11
Correct
Null Beam
Coarse Slew
Motors Off
SLHTR ON
063
DG·16 ON
No
SMEAR
Yes
DG01 on scale. DG04 stable
No
DG01 on Scale
No
Coarse Slew
Yes
Yes
DG·04 stable
No
Hold for Temp. Stabilization
Yes

Figure 2.2-6 (h)



PA gain increment of 9

Figure 2.2-6 (l)

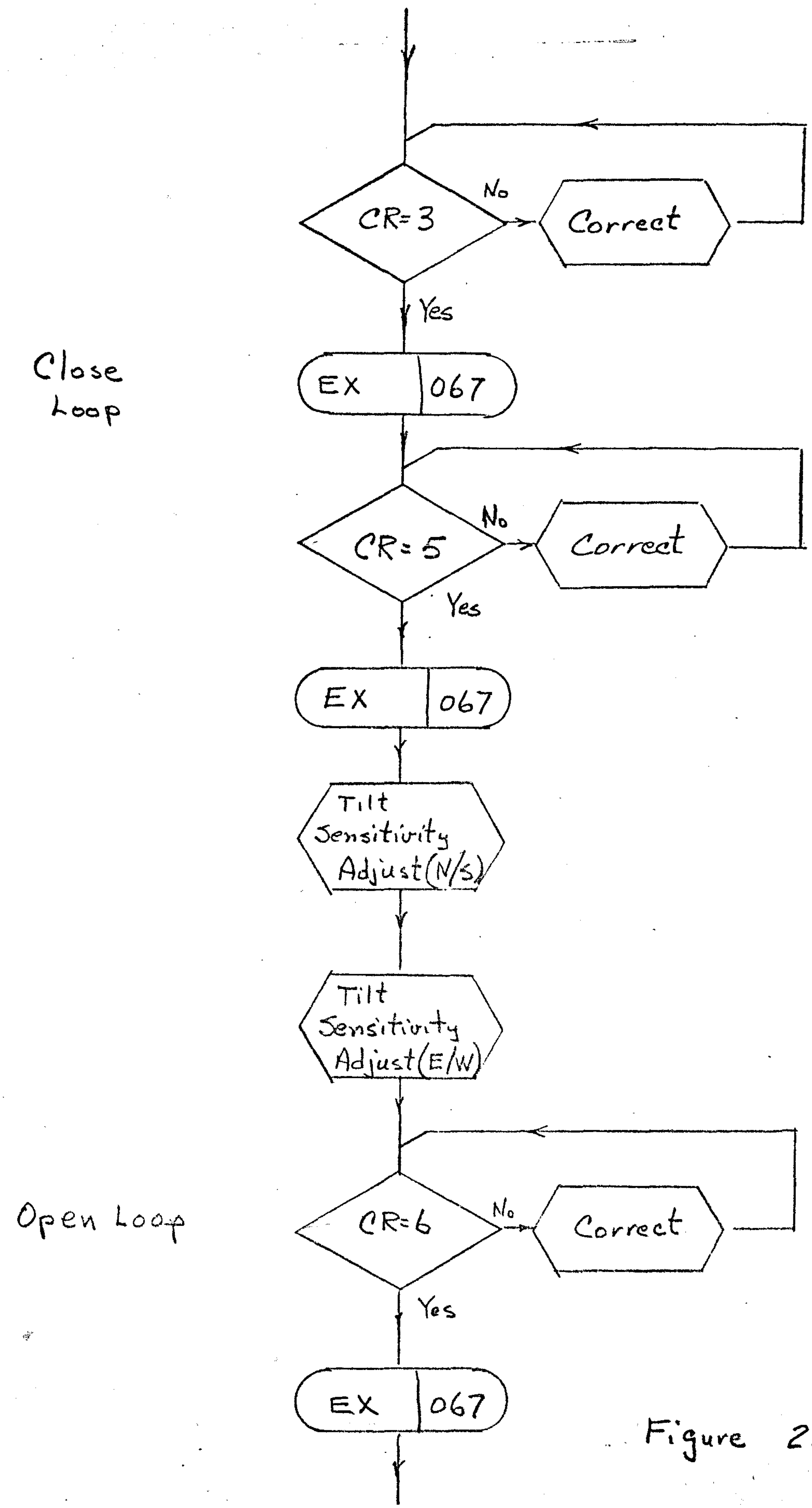

CR=3
No
Correct
Yes
Close Loop
EX
067
CR=5
No
Correct
Yes
EX
067
Tilt Sensitivity Adjust(N/S)
Tilt Sensitivity Adjust(E/W)
Open Loop
CR=6
No
Correct
Yes
EX
067

Figure 2.2-6(j)

Temperature Inversion Test

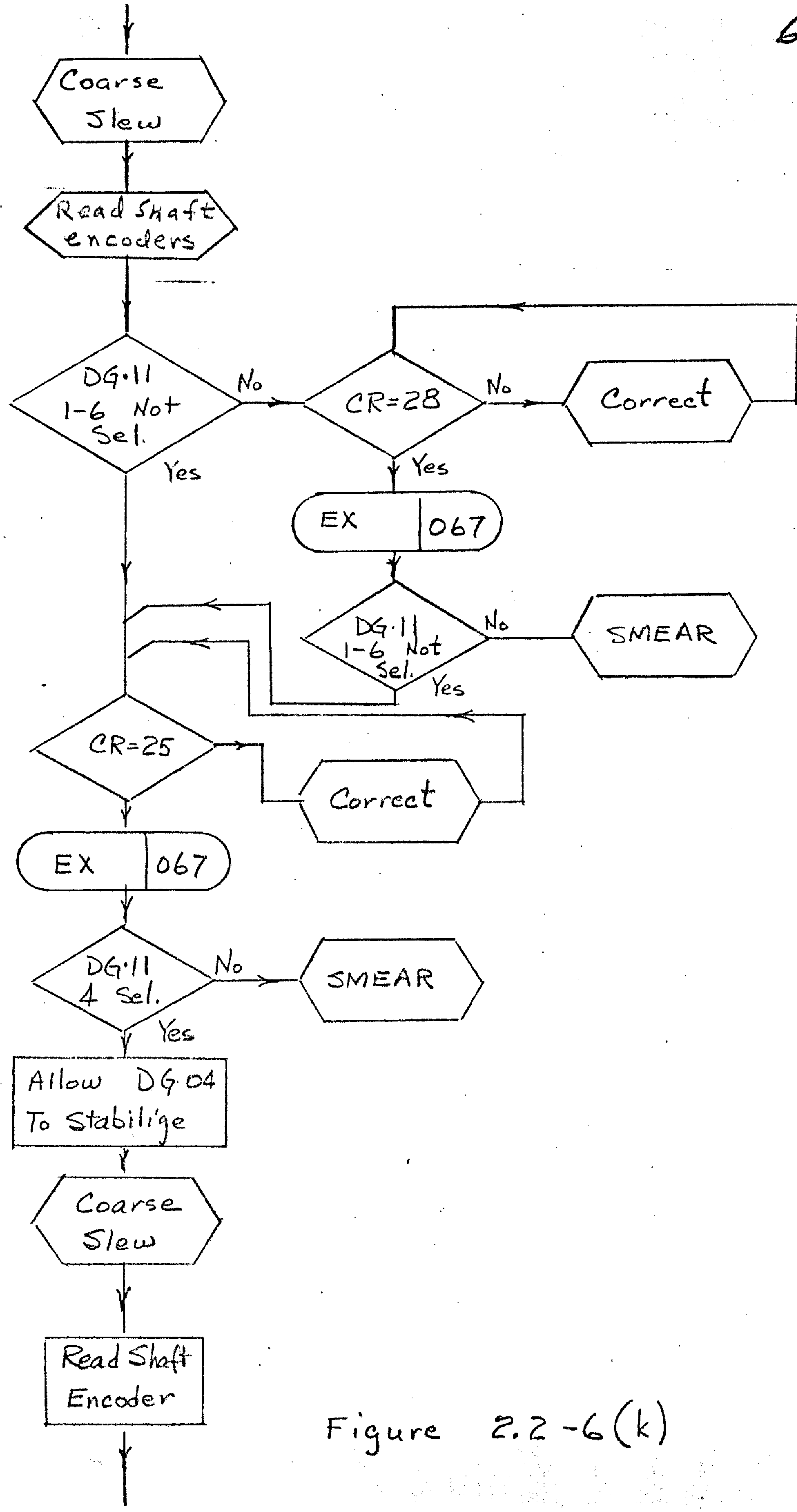
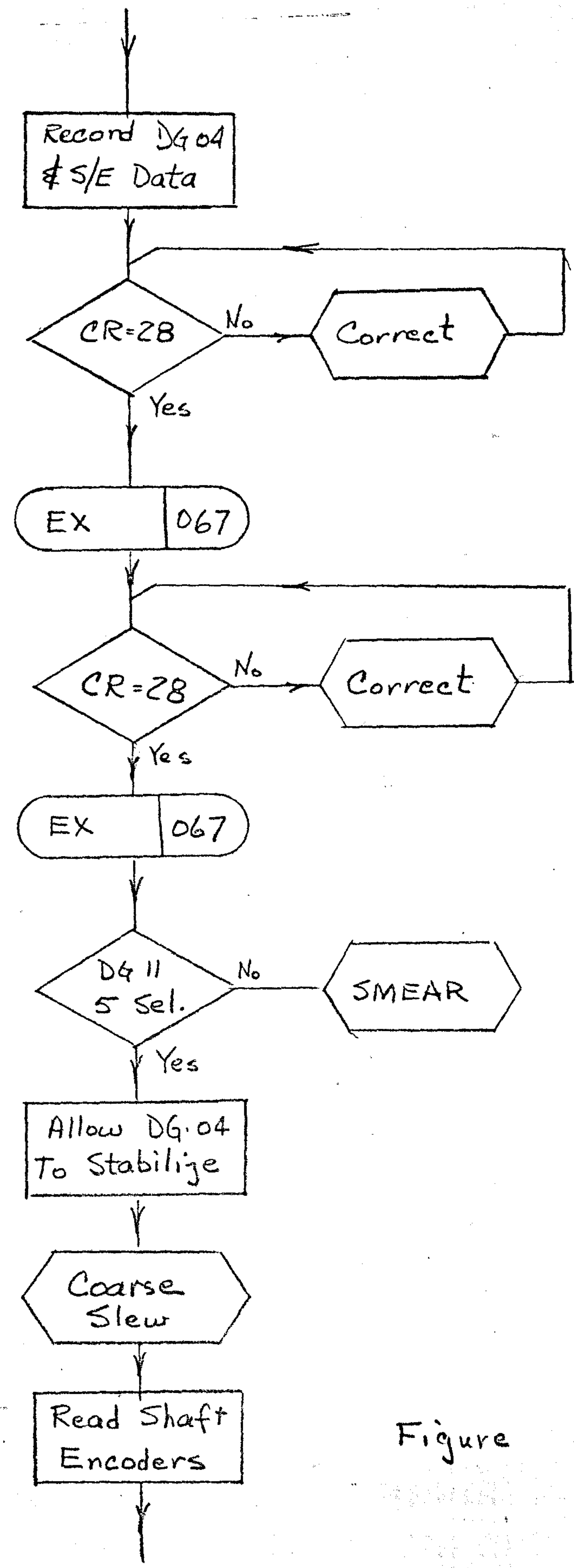


Figure 2.2-6(k)



Record DG 04
& S/E Data
CR=28
No
Correct
Yes
EX
067
CR=28
No
Correct
Yes
EX
067
DG 11
5 Sel.
No
SMEAR
Yes
Allow DG.04
To Stabilize
Coarse
Slew
Read Shaft
Encoders

Figure 2.2-6 (l)

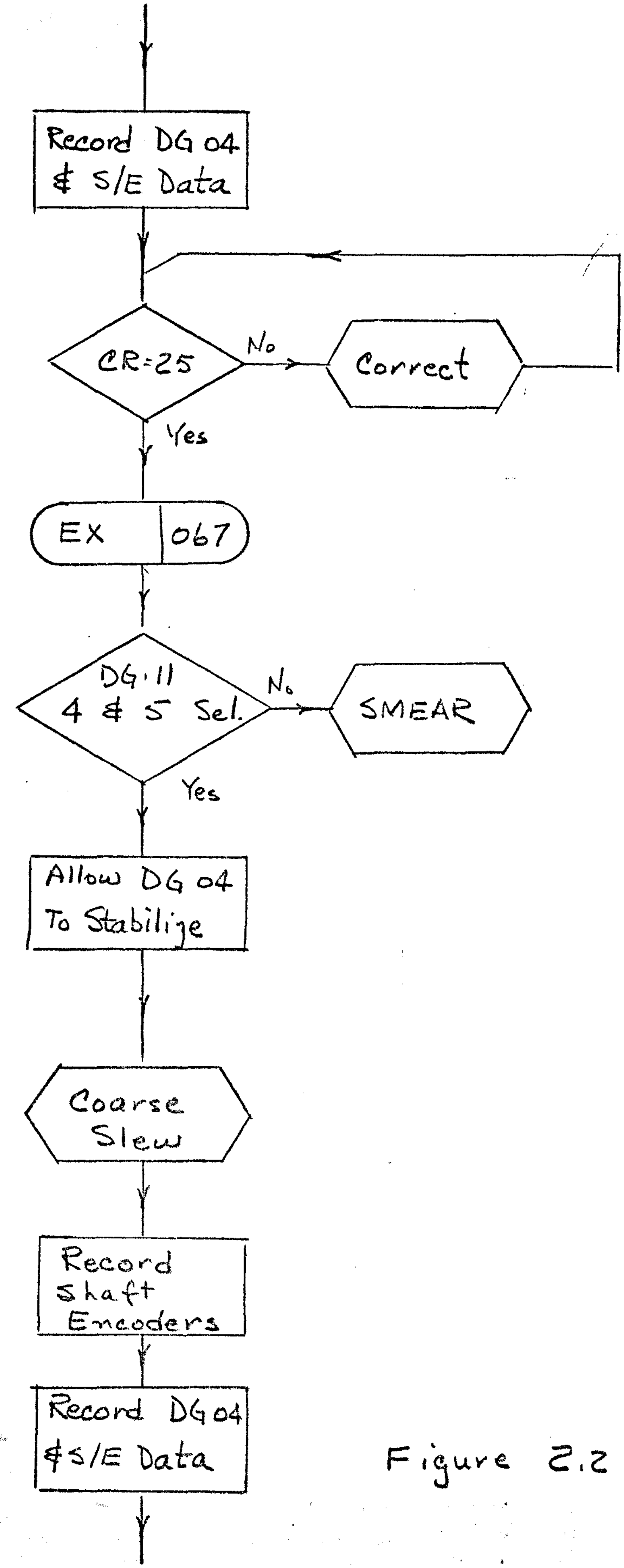

Record DG 04
& S/E Data
CR=25
No
Correct
Yes
EX
067
DG.11
4 & 5 Sel.
No
SMEAR
Yes
Allow DG 04
To Stabilize
Coarse
Slew
Record
Shaft
Encoders
Record DG 04
& S/E Data

Figure 2.2-6(m)

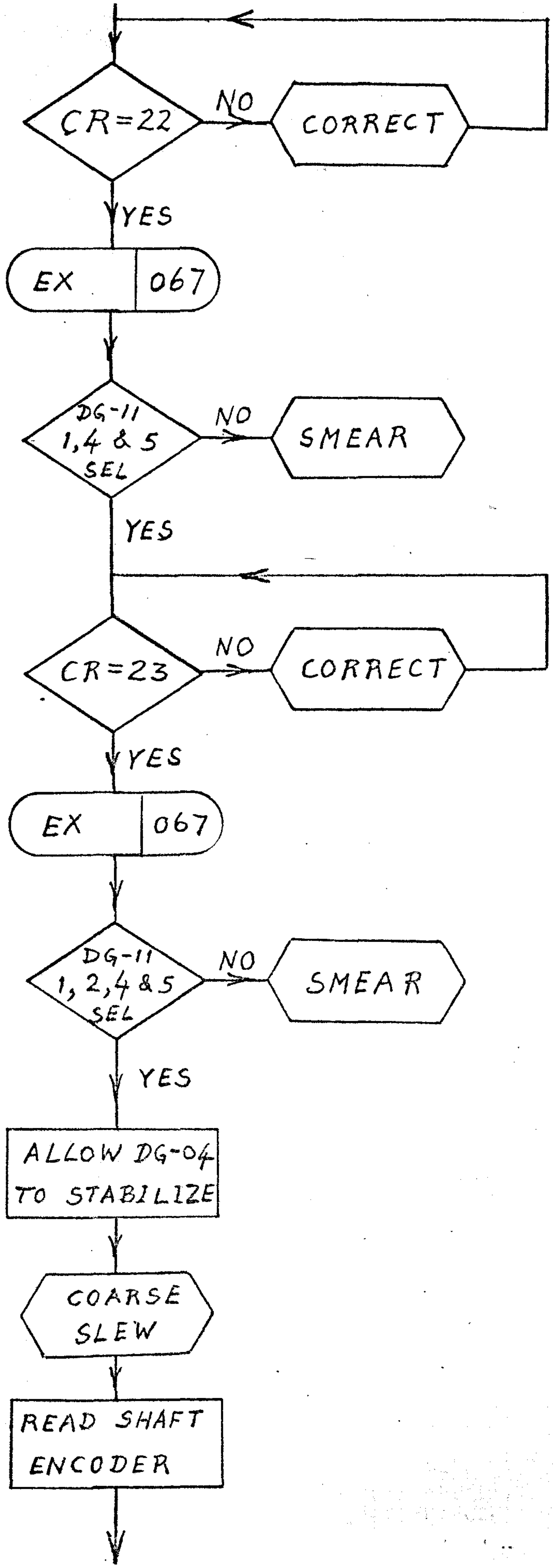
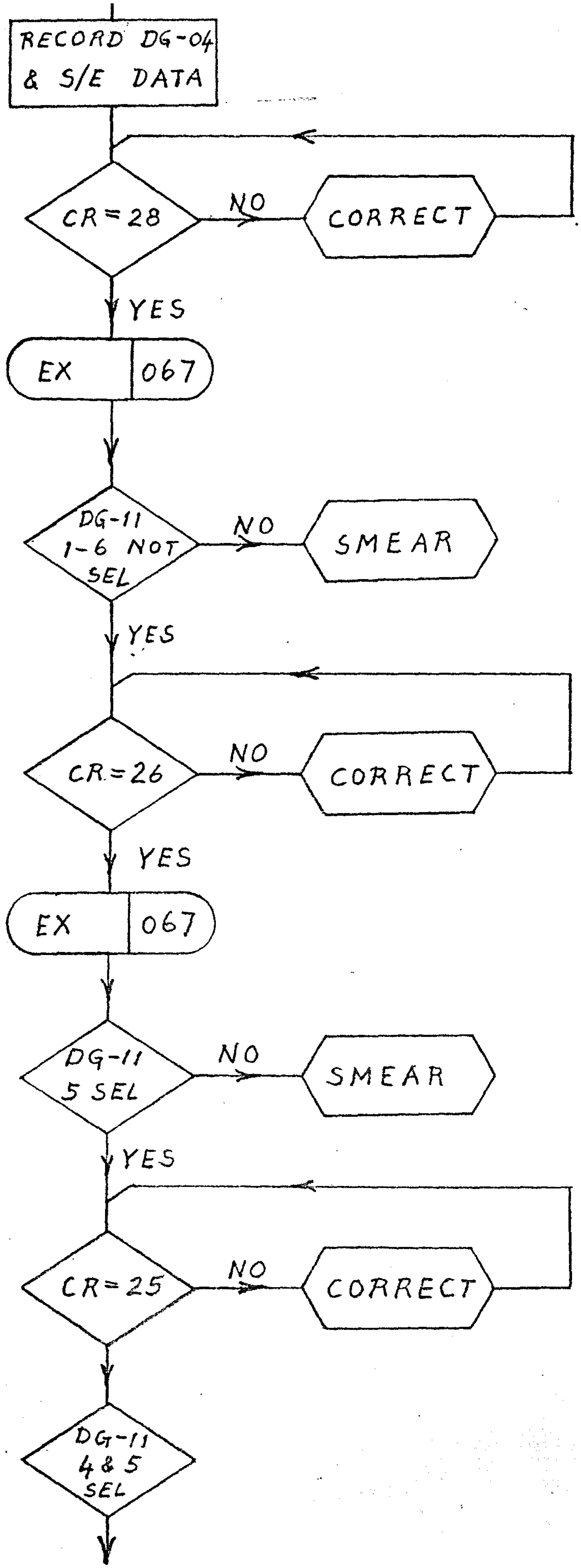

CR=22
NO
CORRECT
YES
EX
067
DG-11
1,4 & 5
SEL
NO
SMEAR
YES
CR=23
NO
CORRECT
YES
EX
067
DG-11
1,2,4 & 5
SEL
NO
SMEAR
YES
ALLOW DG-04
TO STABILIZE
COARSE
SLEW
READ SHAFT
ENCODER

Figure 2.2-6(n)



RECORD DG-04 & S/E DATA
CR=28
NO
CORRECT
YES
EX
067
DG-11 1-6 NOT SEL
NO
SMEAR
YES
CR=26
NO
CORRECT
YES
EX
067
DG-11 5 SEL
NO
SMEAR
YES
CR=25
NO
CORRECT
DG-11 4 & 5 SEL

Figure 2·2-6(o)

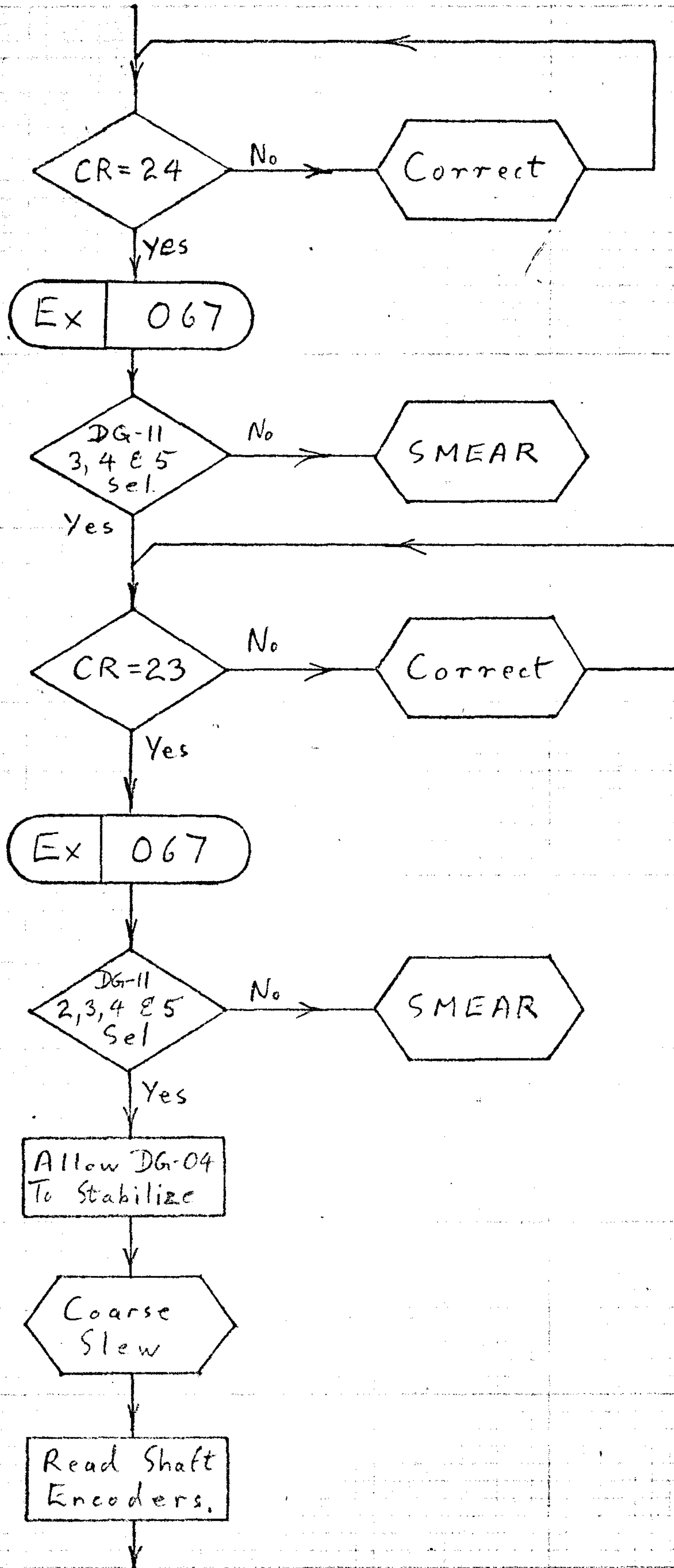

CR=24
No
Correct
Yes
Ex
067
DG-11
3,4 & 5
Sel
No
SMEAR
Yes
CR=23
No
Correct
Yes
Ex
067
DG-11
2,3,4 & 5
Sel
No
SMEAR
Yes
Allow DG-04
To Stabilize
Coarse
Slew
Read Shaft
Encoders.

Figure 2.2-6 (p)

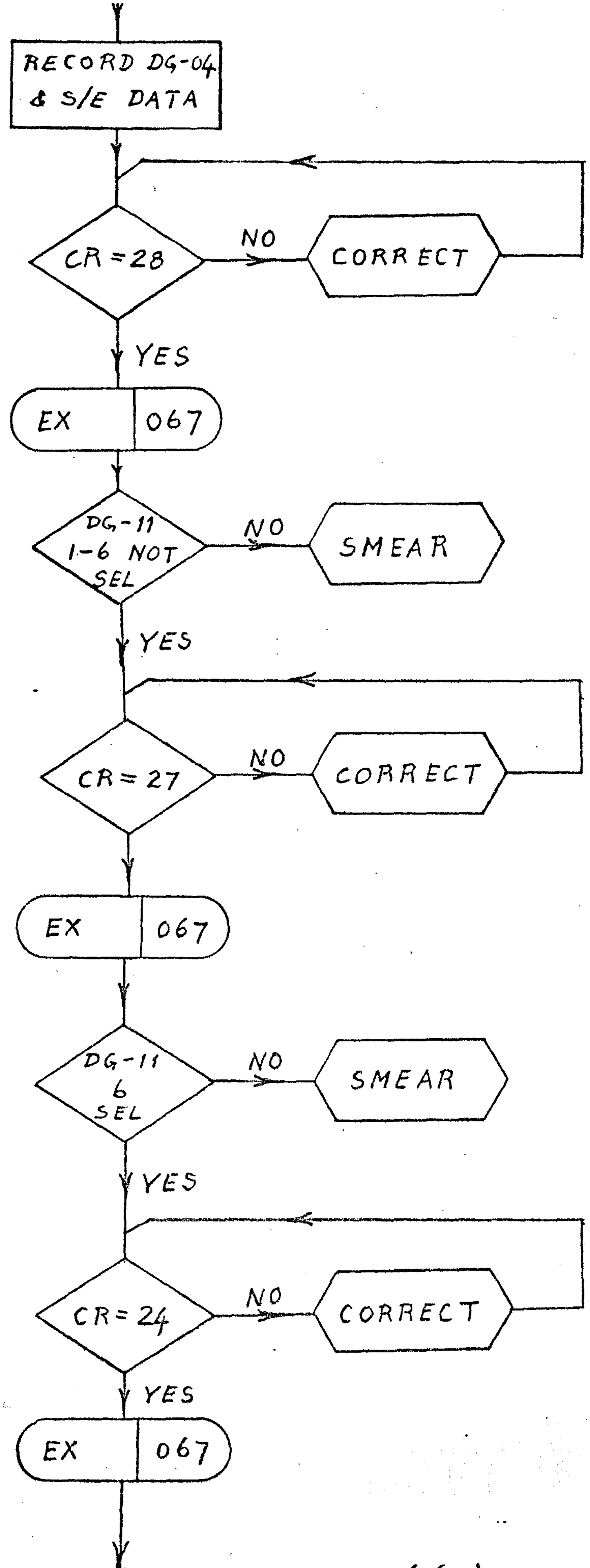

RECORD DG-04 & S/E DATA
CR=28
NO
CORRECT
YES
EX
067
DG-11 1-6 NOT SEL
NO
SMEAR
YES
CR=27
NO
CORRECT
EX
067
DG-11 6 SEL
NO
SMEAR
YES
CR=24
NO
CORRECT
YES
EX
067

Figure 2.2-6(q)

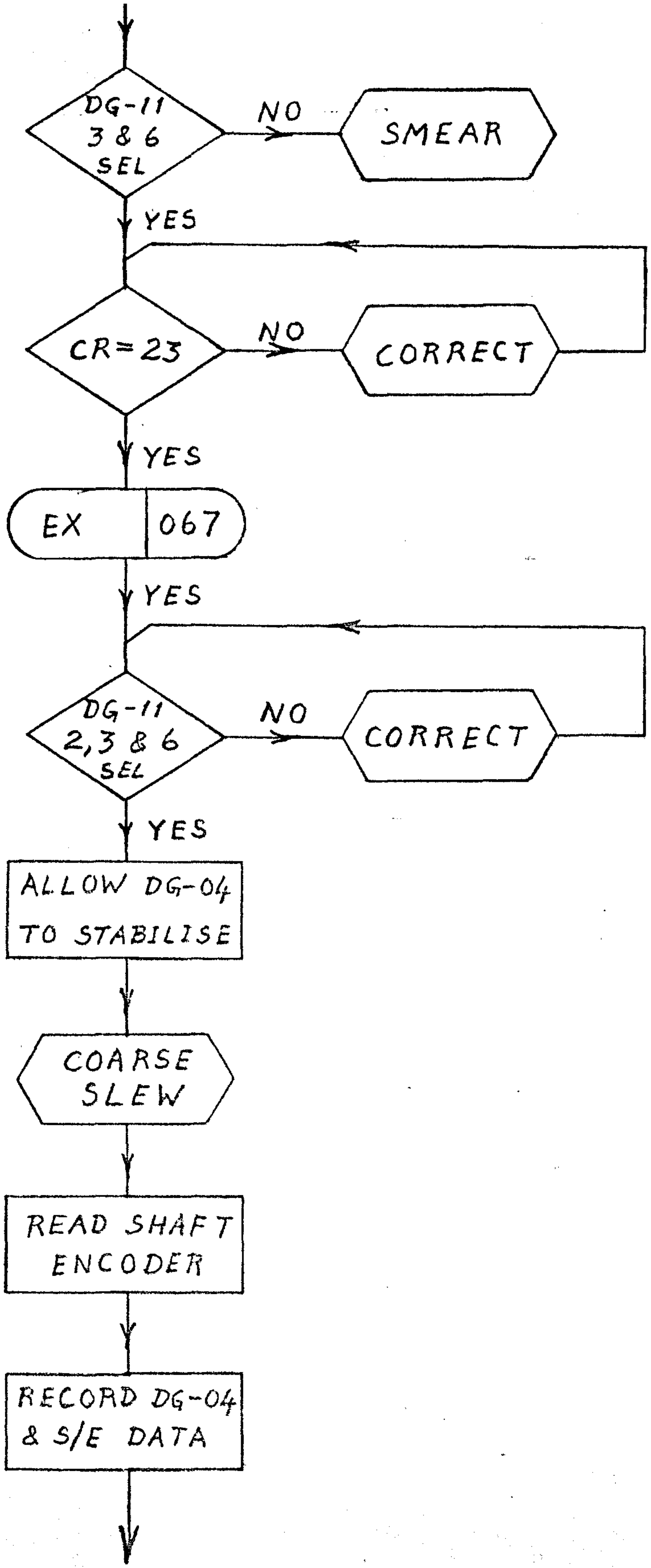

DG-11
3 & 6
SEL
NO
SMEAR
YES
CR=23
NO
CORRECT
YES
EX
067
YES
DG-11
2,3 & 6
SEL
NO
CORRECT
YES
ALLOW DG-04
TO STABILISE
COARSE
SLEW
READ SHAFT
ENCODER
RECORD DG-04
& S/E DATA

Figure 2·2-6 (r)

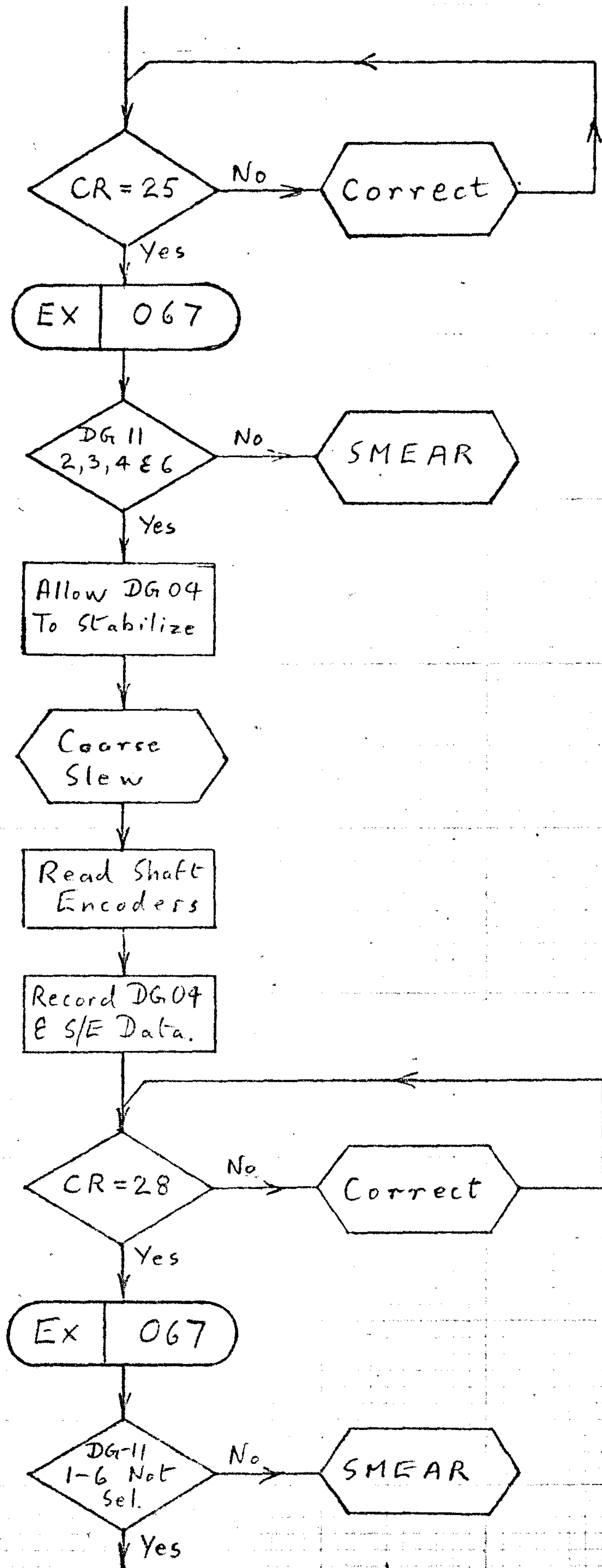
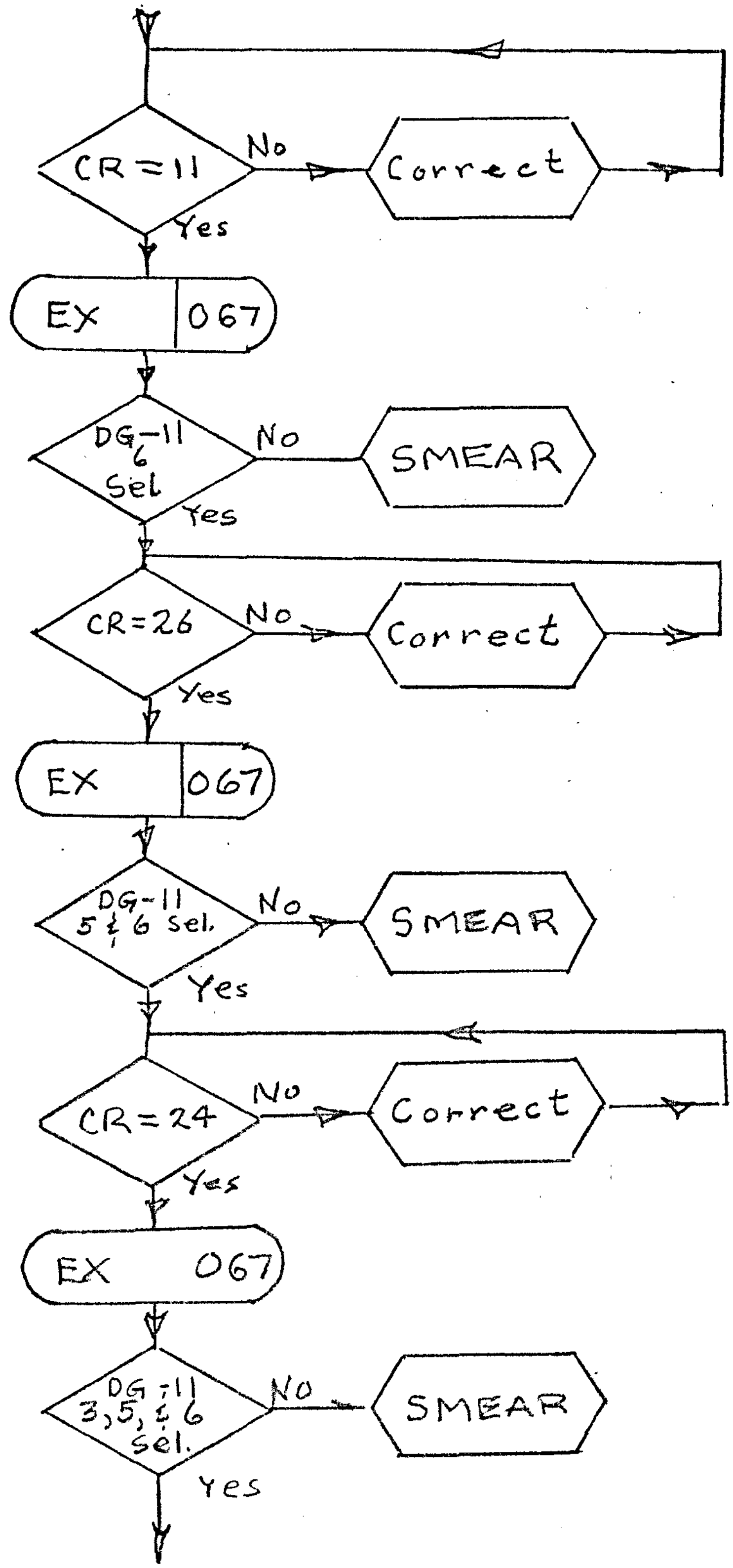

CR=25
No
Correct
Yes
EX
067
DG 11
2,3,4 & 6
No
SMEAR
Yes
Allow DG 04
To Stabilize
Coarse
Slew
Read Shaft
Encoders
Record DG 04
& S/E Data.
CR=28
No
Correct
Yes
Ex
067
DG-11
1-6 Not
Sel.
No
SMEAR
Yes

Figure 2.2-6(s)



CR=11
No
Correct
Yes
EX 067
DG-11 6 Sel
No
SMEAR
Yes
CR=26
No
Correct
Yes
EX 067
DG-11 5 & 6 Sel.
No
SMEAR
Yes
CR=24
No
Correct
Yes
EX 067
DG-11 3, 5, & 6 Sel.
No
SMEAR
Yes

Figure. 2,2-6 (t)

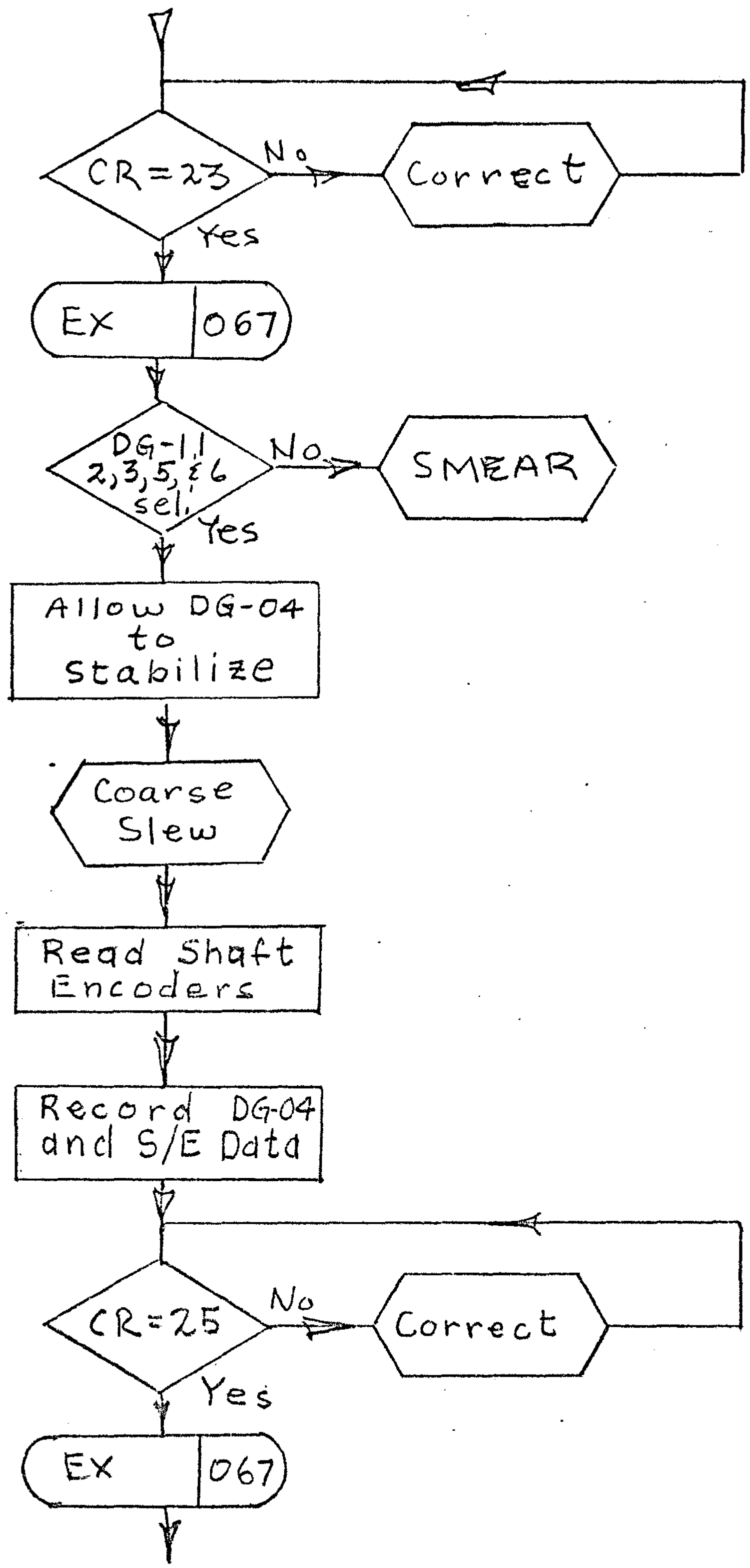
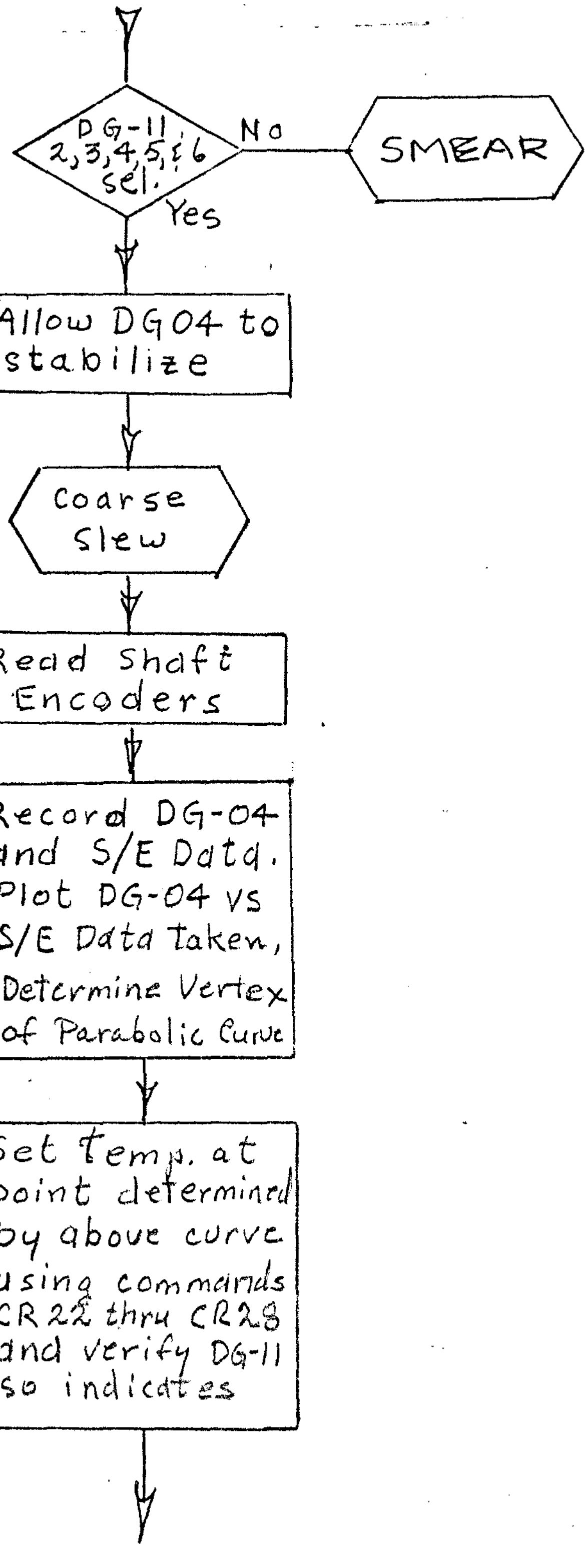
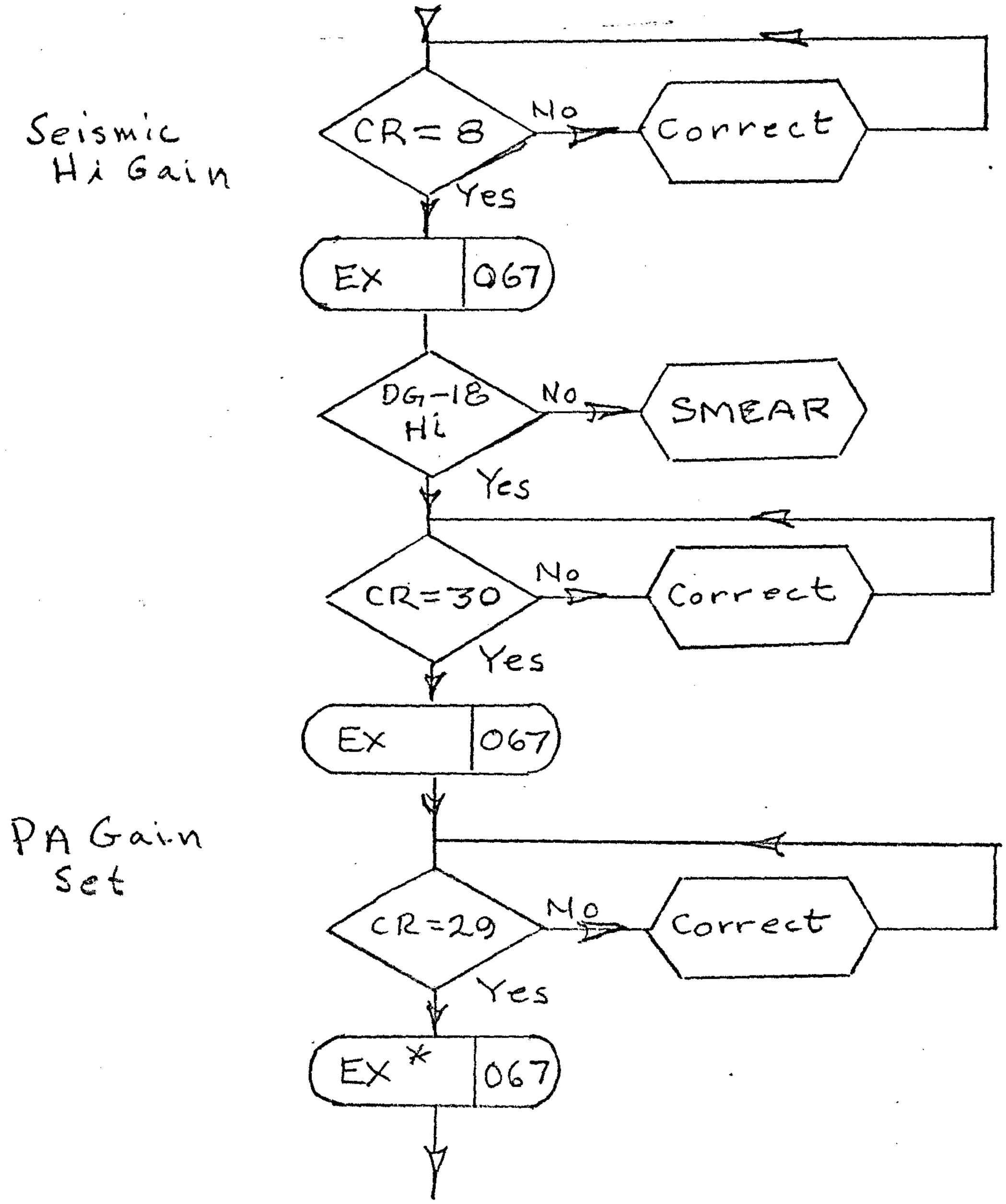

CR=23
No
Correct
Yes
EX
067
DG-1,1
2,3,5,&6
sel.
No
SMEAR
Yes
Allow DG-04
to
stabilize
Coarse
Slew
Read Shaft
Encoders
Record DG-04
and S/E Data
CR=25
No
Correct
Yes
EX
067

Figure 2.2-6 (u)



DG-11
2,3,4,5,&6
sel.
No
SMEAR
Yes
Allow DG04 to stabilize
Coarse Slew
Read Shaft Encoders
Record DG-04 and S/E Data. Plot DG-04 vs S/E Data Taken, Determine Vertex of Parabolic Curve
Set Temp. at point determined by above curve using commands CR22 thru CR28 and verify DG-11 so indicates

Figure 2.2-6 (v)



* Execute that number of times selected by PI,

Figure 2.2-6 (w)

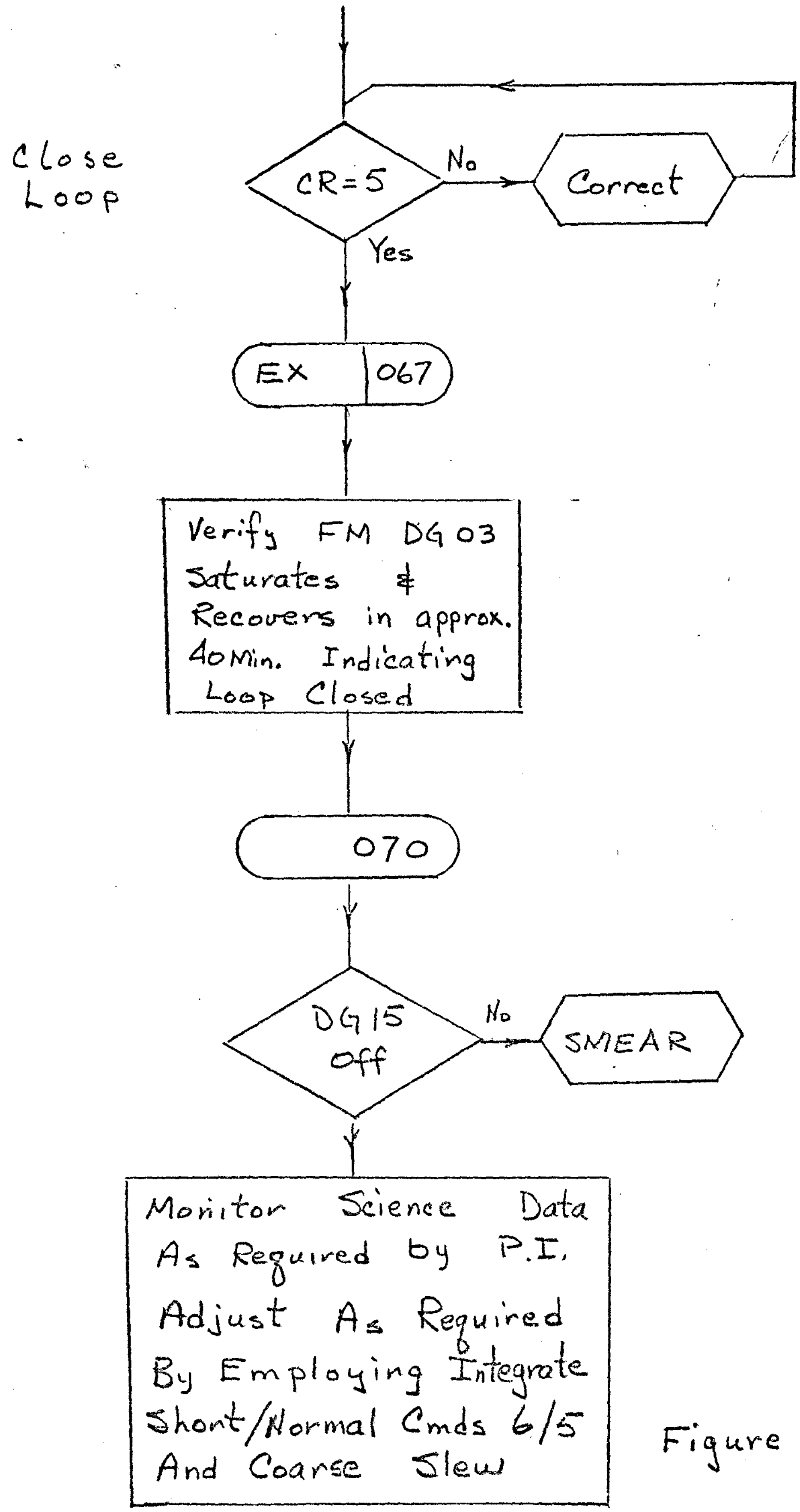

Close Loop
CR=5
No
Correct
Yes
EX 067
Verify FM DG 03 Saturates & Recovers in approx. 40 Min. Indicating Loop Closed
070
DG 15 Off
No
SMEAR
Monitor Science Data As Required by P.I. Adjust As Required By Employing Integrate Short/Normal Cmds 6/5 And Coarse Slew

Figure 2.2-6 (1)

2.2.6 LSP Initialization

The Lunar Seismic Profiling Equipment will not be activated before the end of EVA 3. The scheduling of LSP operations shall be dependent on the predicted detonation times of the deployed explosive packages and the Mission Rules. Figure 2.2-8 presents in flow-chart format the procedure for conducting an LSP operation and restoring Array E to the general operating mode.

Note that unless Astroswitch #2 is turned clockwise (CW) to "ENBL" the LSP experiment will be permanently disabled. It is important that a positive verification of the position of this switch is made before the crew leave the ALSEP deployment site.

LSP ON

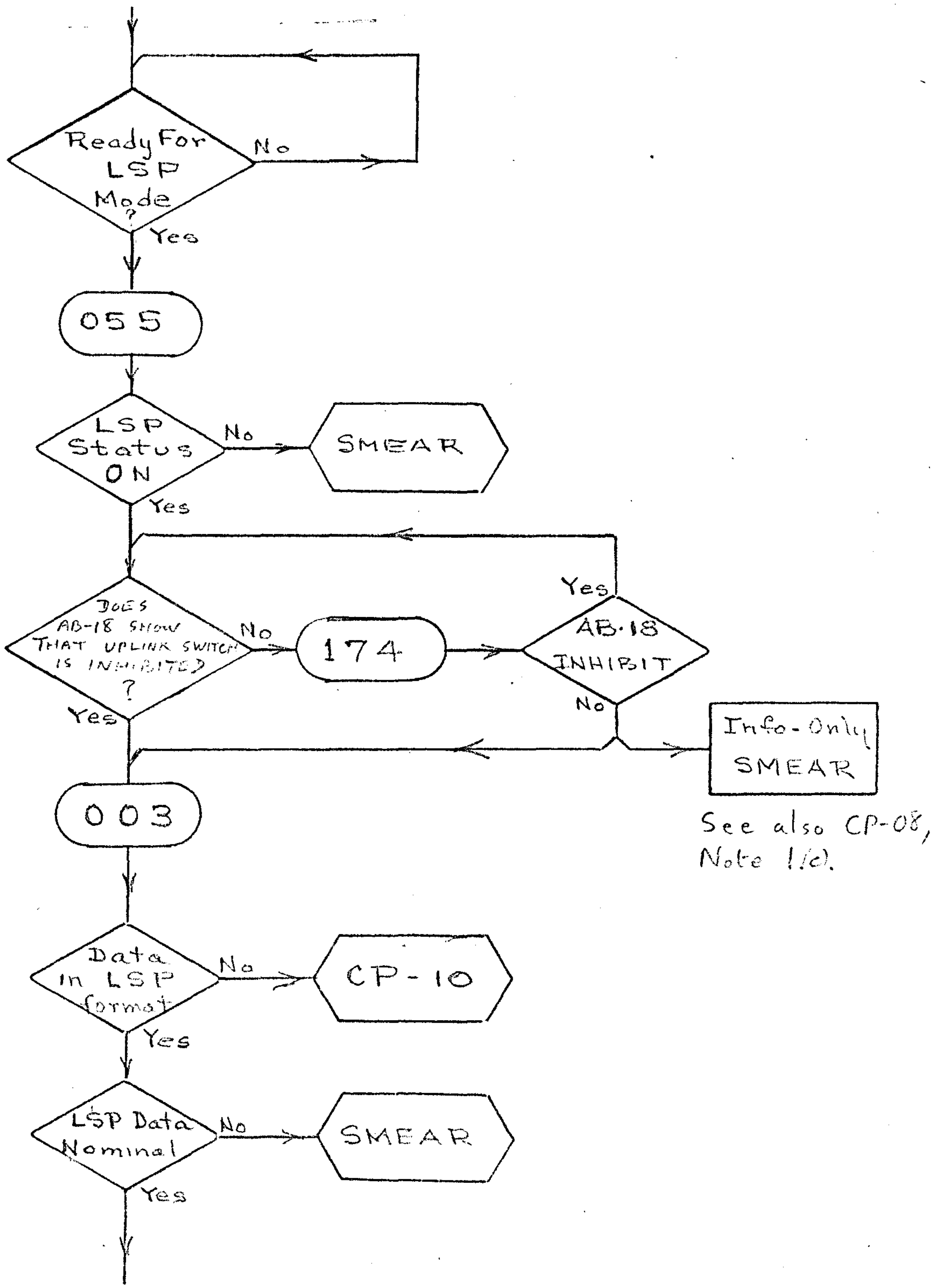
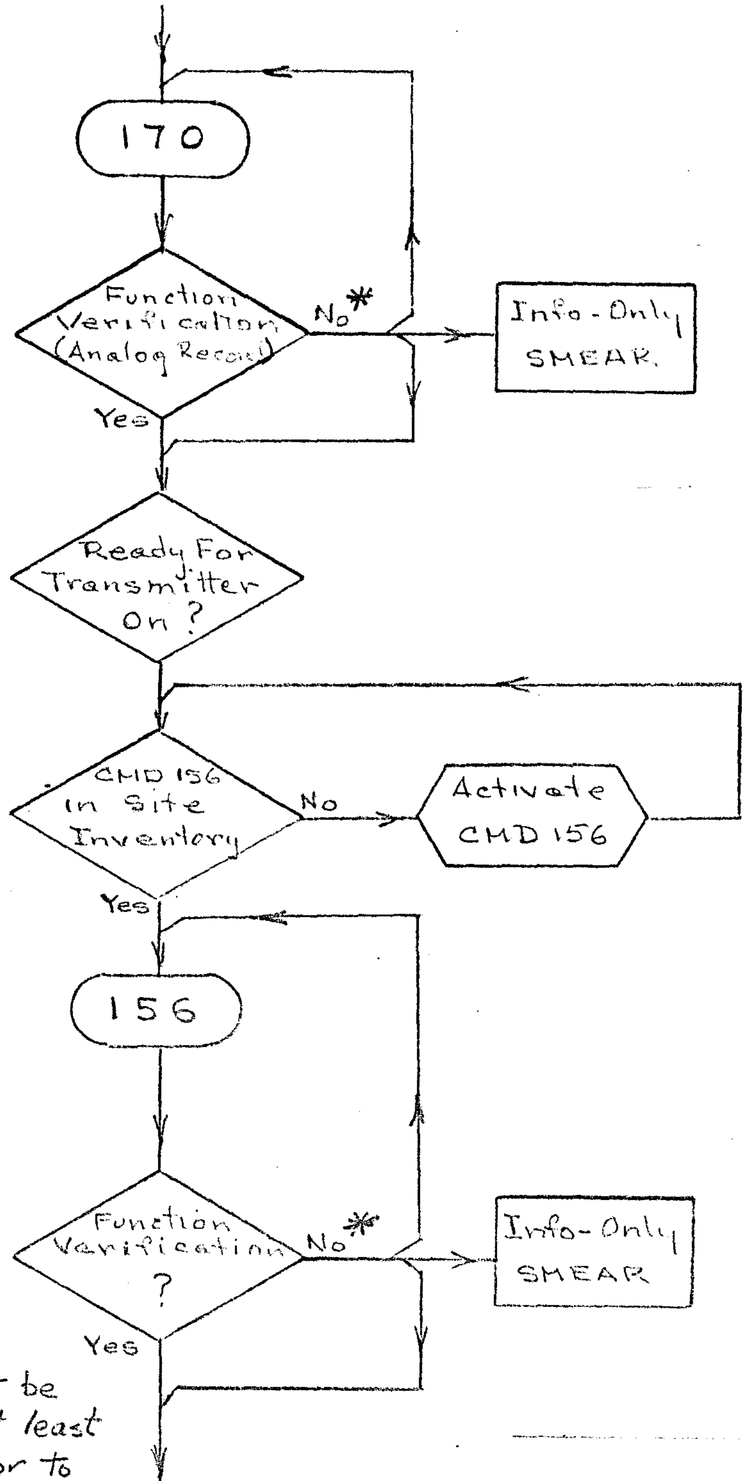


Figure 2.2-7 (a) LSP Operational Sequence

Calibrate Geophones



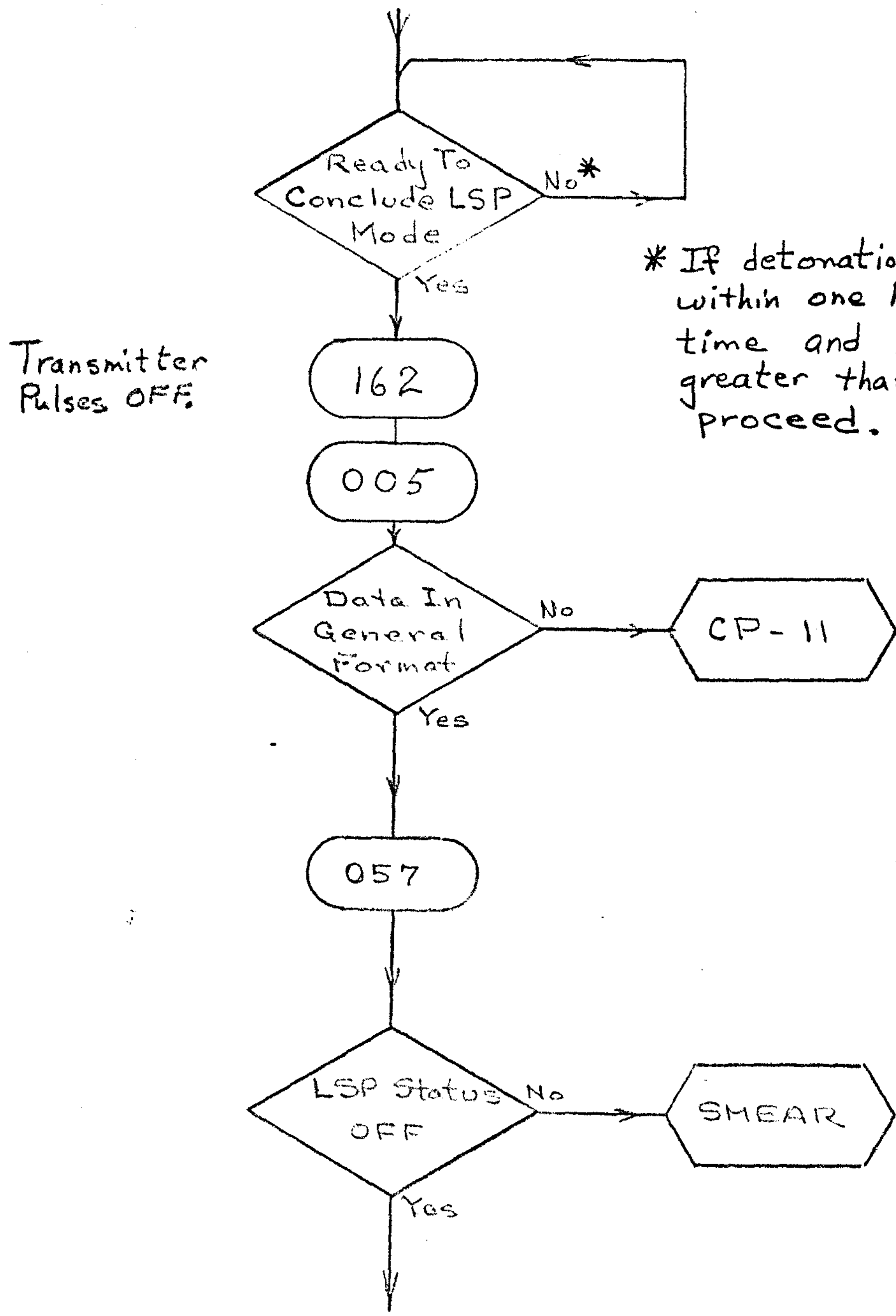
Transmitter Pulses ON.

This sequence is omitted during passive listening periods, including LM lift-off and LM impact.

This point must be accomplished at least 45 minutes prior to nominal detonation time.

* Per Mission Rules, Repeat the Command, and then proceed because of Time Limitation.

Figure 2.2-7 (b)



* If detonation has not occurred within one hour after nominal time and next detonation is greater than two hours away — proceed.

Figure 2.2-7 (c)

2.3 Continuing Operational Requirements

Throughout the life of Array E, the data provided in the telemetry downlink shall be recorded continuously.

For the first 45 days of lunar operation of ALSEP Array E the performance of all equipments shall be monitored in real time in the ALSEP System Support room of Mission Control Center at NASA/MSC. When the scientific instruments have been initialized to the satisfaction of the cognizant principal investigators, the performance of each item (including the Central Station) shall be recorded by hard copy printout at least once every two hours.

The relative priorities of the Array E scientific instruments has been established as follows:

HFE
LSP
LSG
LMS
LEAM

2.3.1 LSP Operations

Following coverage of the explosive package detonations, the LSP will be operated in a 30-minute listening mode once per week. The normal bit rate for the listening mode is 3533 bps, with 1060 bps available as a back-up data rate.

2.3.2 HFE Operations

In addition to operation in the normal mode, the following special operations shall be scheduled:

(a) During the 45-day period of continuous, real-time MCC support a ring bridge survey shall be conducted each Earth day. Following this time a similar survey shall be conducted once per week.

(b) During the second lunar day, after the measured temperature patterns have been established, 8 Mode 2 conductivity tests will be performed. Each test requires approximately 40 hours of operation for a total elapsed time of approximately 350 hours.

(c) At the end of the first year of operation a Mode 3 conductivity test shall be performed.

2.3.3 <u>Other Scientific Instruments</u>

Once the other sensors are initialized any changes in normal operating mode shall be at the direction of the cognizant principal investigator.

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The contingencies in this section are the more obvious ones which could occur during the initial Array E operations, when very little information will be available as to the status of the system, and when there will be no history of behavior in the lunar environment. Contingencies which occur after normal operation has been established are not covered specifically, since there are so many possibilities and because in general they should be quite straightforward to deal with, probably requiring only one or two fairly obvious commands.

Contingency Procedure #CP-01

CP-01

Clue: During test of RTG shorting switch, meter does not read zero when short is removed.

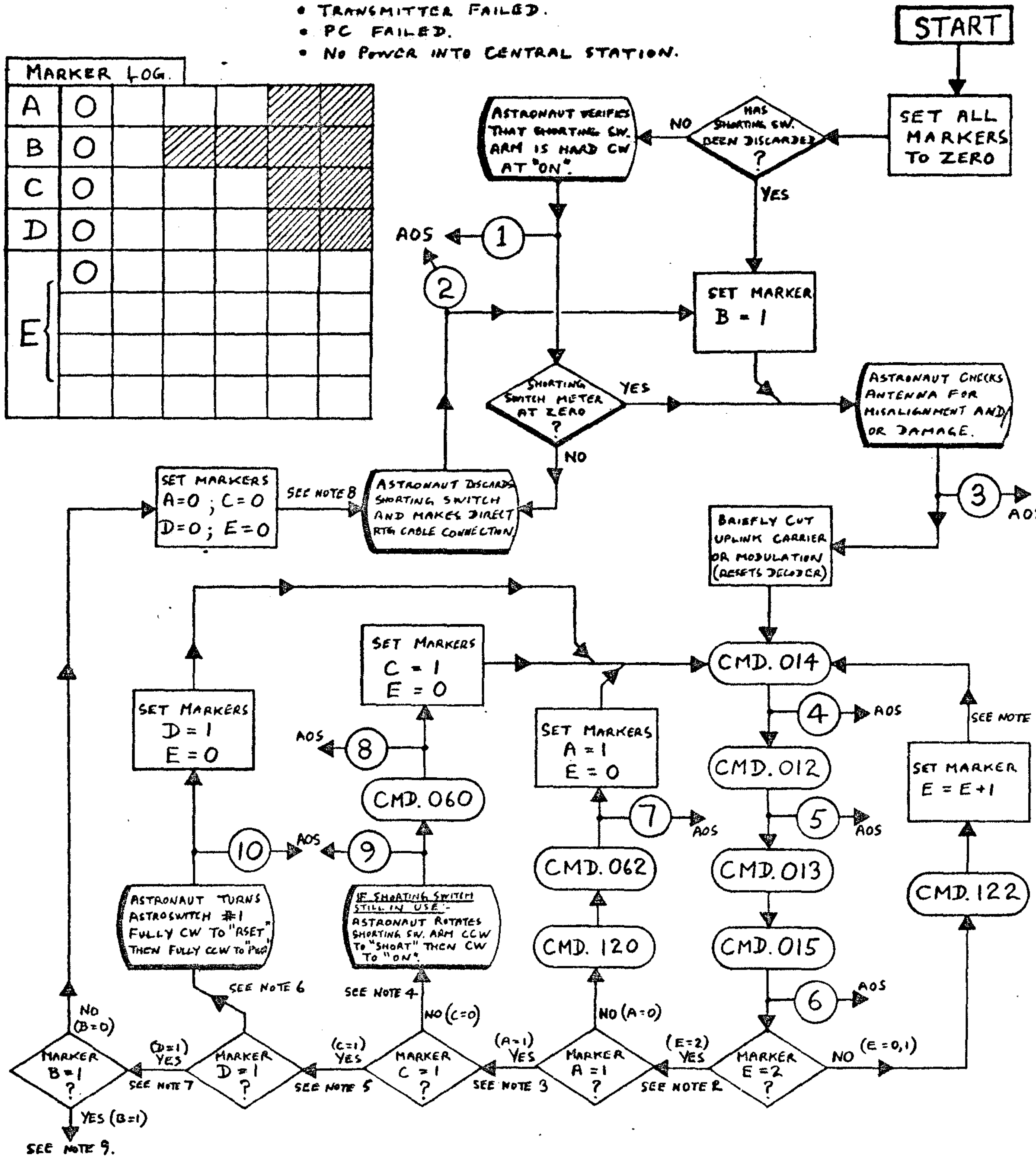
Procedure:

The crew shall separate the shorting switch assembly from the RTG cable and discard it.

The crew shall then mate the RTG cable connector with the Central Station bulkhead connector and proceed with normal ALSEP deployment.

CONTINGENCY PROCEDURE CP-02: NO AOS AT TURN-ON

POSSIBLE CAUSES:
- INSUFFICIENT TIME FOR RTG WARM-UP — VERIFY.
- MISALIGNED OR DAMAGED ANTENNA OR CABLE.
- BOTH TRANSMITTERS TURNED OFF.
- TRANSMITTER FAILED.
- PC FAILED.
- NO POWER INTO CENTRAL STATION.



NOTES.

1. THIS LOOP IS FOLLOWED TWICE TO REMOVE POSSIBLE DESYNCHRONIZATION IN UPLINK CONTROL CIRCUITS.
2. SINGLE POINT RF FAILURE OR +29 VOLT FAILURE OR TRANSMITTERS OFF, NO UPLINK.
3. ALMOST CERTAINLY NO UPLINK AVAILABLE.
4. POSSIBLE THAT SYSTEM WAS ALREADY IN PC#2 AND PC#2 FAILED. THIS IS ATTEMPT TO SWITCH BACK TO PC#1. (LOW PROBABILITY).
5. ASSUME COMPLETE FAILURE OF PC#1 OR NO POWER INTO SYSTEM.
6. OPERATION OF A/S #1 IS DELAYED UNTIL NOW SINCE IT OVERRIDES THE PROTECTION OF THE AUTOSWITCH CIRCUIT.
7. SINGLE POINT RF FAILURE OR NO POWER INTO SYSTEM.
8. REMOVAL OF SHORTING SWITCH MAY DISTURB C/S ALIGNMENT.
9. PROBABLE SINGLE-POINT RF OR POWER FAILURE, OR EXTENSIVE SCRAMBLING OR MULTIPLE FAILURES. PROBABILITY OF RECOVERY IS LOW, BUT CONTINUE WITH LOST UPLINK PROCEDURES FOR UP TO 300 HOURS.

DIAGNOSES.

EXIT POINT.

1. SHORTING SWITCH NOT SET CORRECTLY.
2. SHORTING SWITCH HAD FAILED.
3. STATION AND/OR ANTENNA MISALIGNED.
4. TRANSMITTER B WAS ON AND HAD FAILED. } UPLINK IS OK.
5. TRANSMITTER A WAS OFF. } UPLINK IS OK.
6. TRANSMITTER A HAD FAILED. } UPLINK IS OK.
7. PC#1/PDU#1 HAD FAILED ON +29 VOLTS. } UPLINK IS OK.
8. SYSTEM WAS IN PC#2. PC#2 FAILED ON +29 VOLTS } UPLINK IS OK.
9. SYSTEM WAS IN PC#2. PC#2 FAILED ON +29 VOLTS.
10. PC#1/PDU#1 HAD FAILED EXTENSIVELY.

UPON AOS RETURN TO TOP OF FIGURE 2.2-1(b)

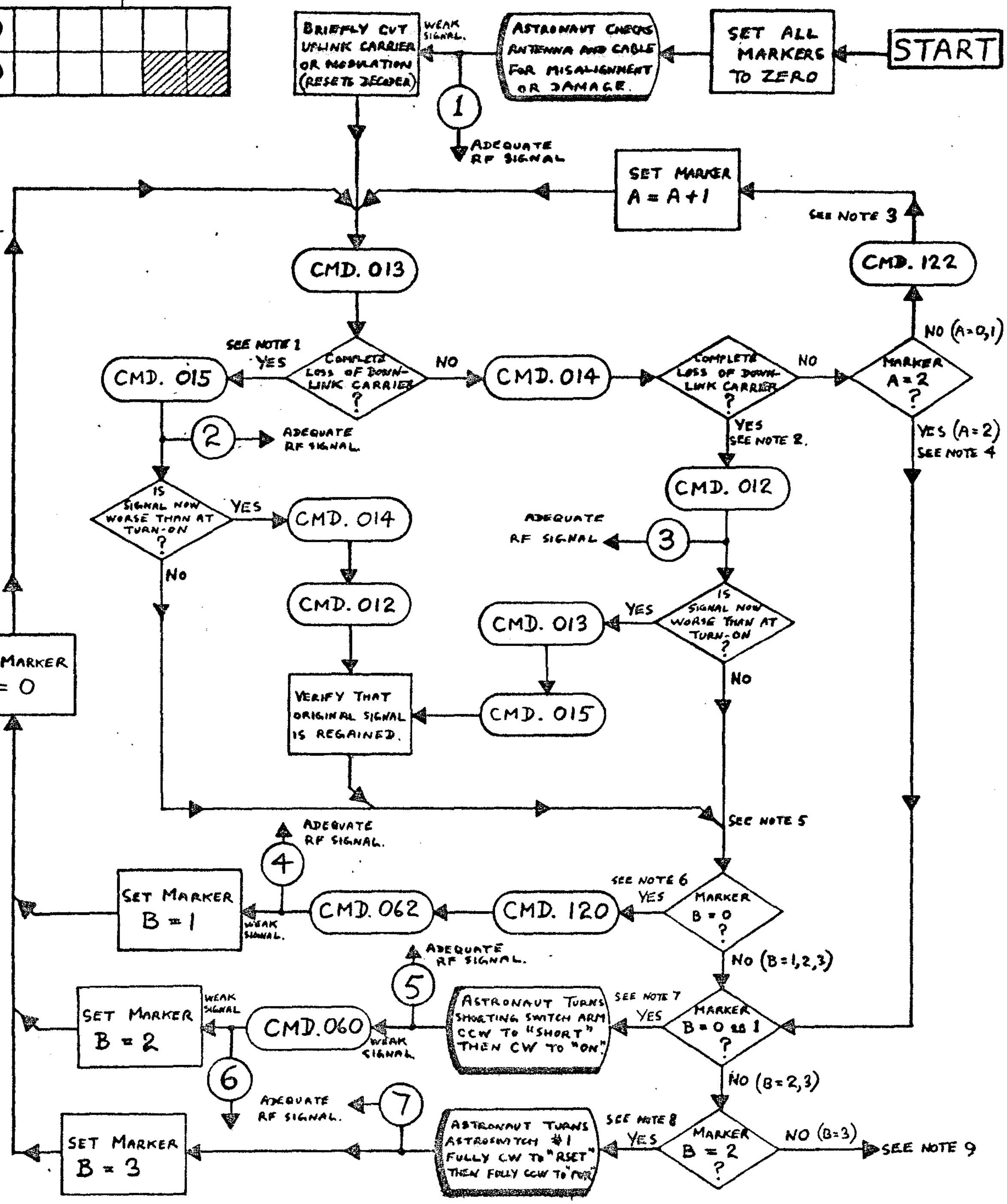
CONTINGENCY PROCEDURE CP-03:- WEAK RF CARRIER AT TURN-ON.

POSSIBLE CAUSES:-
- INSUFFICIENT TIME FOR RTG WARM-UP – VERIFY.
- MISALIGNED OR DAMAGED ANTENNA OR CABLE.
- FAILING TRANSMITTER.
- FAILING PCU/PDU.

CONTINGENCY PROCEDURE IS BASED UPON ASSUMPTIONS THAT: a) A LARGER GROUND-STATION DISH IS NOT AVAILABLE b) DECOM-LOCK CANNOT BE ACHIEVED c) PROBABLE CONFIGURATION IS PC#1 ON, TRANSMITTER A ON, TRANSMITTER B OFF.

MARKER LOG

A	0					
B	0					



NOTES

1. UPLINK IS OK. Tx.A WAS ON.
2. UPLINK IS OK. Tx.B WAS ON.
3. THIS LOOP IS COVERED TWICE TO REMOVE POSSIBLE DESYNCHRONIZATION OF UPLINK CONTROL CIRCUITS.
4. ALMOST CERTAINLY NO UPLINK AVAILABLE.
5. UPLINK IS OK. PROBABLY +29 VOLT FAILURE.
6. SELECTING PC#2 BY COMMAND IS PREFERRED TO USE OF A/S #1: MAINTAINS AUTOSWITCH PROTECTION.
7. POSSIBLE THAT SYSTEM WAS ALREADY ON PC#2. THIS IS ATTEMPT TO SELECT PC#1.
8. OPERATION OF A/S #1 IS DELAYED UNTIL NOW SINCE IT OVERRIDES AUTOSWITCH PROTECTION.
9. IF A = 0 OR 1, I.E. UPLINK OK, THEN IMPROVED DOWNLINK SIGNAL IS UNLIKELY. USE LARGER DISH.

   IF A = 2, I.E. NO UPLINK, THERE MAY BE A COMMON SINGLE POINT FAILURE IN RF CIRCUITS, E.G. DIPLEXER, OR THERE MAY BE MULTIPLE FAILURES AND SCRAMBLING, WITH POSSIBLE EVENTUAL RECOVERY. ~~FOLLOW LAST UPLINK PROCEDURE~~ AND USE LARGER DISH.

DIAGNOSES.

EXIT POINT

1. STATION AND/OR ANTENNA MISALIGNED.
2. TRANSMITTER A HAD FAILED.
3. TRANSMITTER B WAS ON, AND HAD FAILED.
4. PC#1 HAD FAILED ON +29 VOLTS.

5,6. SYSTEM WAS IN PC#2, AND PC#2 HAD FAILED.

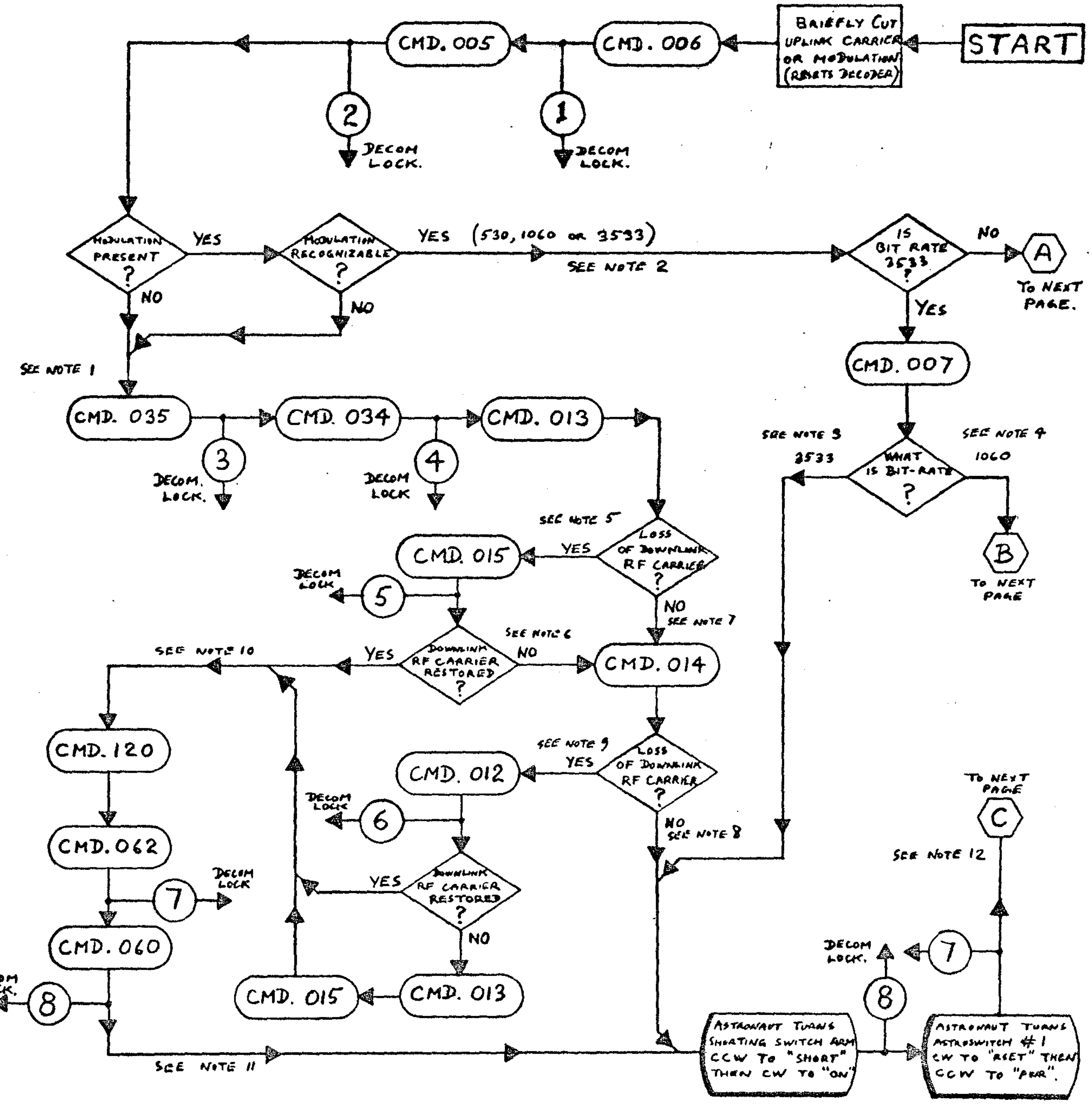
7. PC#1 HAD FAILED.

RETURN TO TOP OF FIGURE 2.2-1(b).

CONTINGENCY PROCEDURE CP-04 :- NO DECOM LOCK AT TURN-ON

POSSIBLE CAUSES :-
- ALSEP IN INCORRECT FORMATTING MODE AND/OR BIT-RATE; MAY BE CORRECTABLE BY COMMAND OR MAY BE CAUSED BY DATA PROCESSOR, COMMAND DECODER OR PCU/PDU FAILURE.
- NO MODULATION, DUE TO DATA PROCESSOR, TRANSMITTER OR PCU/PDU FAILURE.
- MODULATION AT CORRECT BIT-RATE, BUT NO FORMATTING AND/OR NO BARKER CODE, DUE TO DATA PROCESSOR FAILURE.

CONTINGENCY PROCEDURE IS BASED UPON ASSUMPTIONS THAT a) GROUND STATION IS SET TO DECOM DATA PROCESSOR FORMAT, NORMAL BIT-RATE (1060) AND b) DOWNLINK SIGNAL STRENGTH IS ADEQUATE — IF NOT, SEE CP-03.



NOTES

1. FAULT COULD BE IN TRANSMITTER, D/P OR PCU/PDU.
2. TRANSMITTER AND D/P MODULATOR SECTION ARE OK.
3. DEFINITELY NO UPLINK, AND/OR MULTIPLE FAULTS.
4. UPLINK OK. FAULT IN C/D OR D/P FORMAT CONTROL.
5. UPLINK OK. FAULT IS IN TRANSMITTER OR PCU/PDU.
6. TRANSMITTER B APPEARS TO HAVE FAILED.
7. NO UPLINK OR TRANSMITTER B IS ON.
8. NO UPLINK. FAULT IS PROBABLY IN PCU/PDU.
9. TRANSMITTER B WAS ON.
10. FAULT IS ALMOST CERTAINLY IN PDU.
11. MULTIPLE FAULTS EXIST IN C/D AND PDU.
12. IF NO MODULATION IS PRESENT AT THIS POINT, THEN SYSTEM IS UNLIKELY TO RECOVER, BUT PROCEDURE SHOULD BE FOLLOWED FROM 'START' ONCE MORE, BEFORE ABANDONING.
    IF MODULATION IS PRESENT, TRY FOLLOWING PROCEDURE ONCE MORE FROM "START" BEFORE WAITING FOR UPLINK CHANGE.

DIAGNOSES.
EXIT POINT

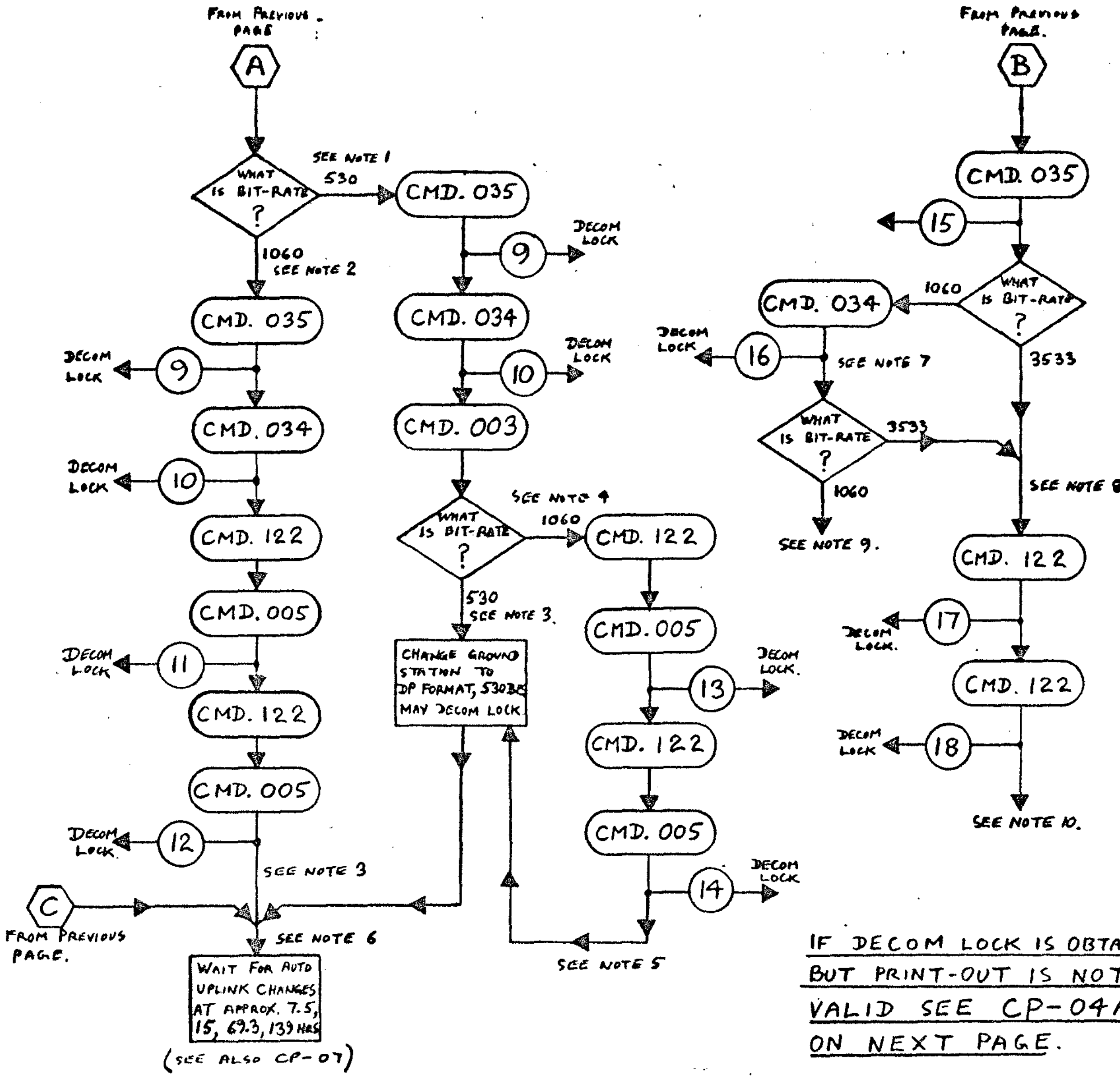
1. SYSTEM WAS IN INCORRECT BIT-RATE; PROBABLY POWER RESET FAILURE IN D/P.
2. SYSTEM WAS IN INCORRECT MODE; PROBABLY POWER RESET FAILURE IN C/D.
3. FAULT WAS IN D/P X.
4. SYSTEM WAS ALREADY IN D/P Y; FAULT IN D/P Y.
5. FAULT AT TRANSMITTER "A" MODULATION INPUT INTERFACE.
6. TRANSMITTER "B" WAS ON. FAULT AT MODULATION INPUT INTERFACE.
7. FAULT IN PDU #1 CIRCUITS TO D/P.
8. SYSTEM WAS ALREADY IN PCU #1/PDU #1. FAULT IN PDU #2.

AFTER ACHIEVING DECOM LOCK

RETURN TO FIGURE 2.2-1(b).

CONTINGENCY PROCEDURE CP-04 (CONTD).

(SEE PREVIOUS PAGE FOR START OF CONTINGENCY PROCEDURE.)



IF DECOM LOCK IS OBTAINED BUT PRINT-OUT IS NOT VALID SEE CP-04A ON NEXT PAGE.

NOTES.

1. MODE IS CORRECT. FAULT IS IN BIT-RATE COMMAND OR MEMORY CIRCUITS.
2. EITHER NO BARKER CODE (D/P FAULT), OR BOTH MODE AND BIT-RATE SELECTION CIRCUITS ARE FAULTY (D/P AND/OR C/D).
3. ALMOST CERTAINLY NO UPLINK.
4. THIS IS LSPE SLOW MODE. UPLINK O.K.
5. SYSTEM WILL OPERATE ONLY IN SLOW MODE. PROBABILITY OF IMPROVEMENT IS LOW.
6. IF BIT-RATE IS 1060 BPS, THEN CHANGE SHOULD OCCUR AT 7.5 AND/OR 69.5 HOURS AFTER TURN-ON. IF BIT-RATE IS 530 BPS THEN CHANGE SHOULD OCCUR AT 15 OR 139 HRS.
7. COULD BE DOUBLE BARKER CODE FAILURE, BUT MORE LIKELY TO BE C/D FAULT.
8. D/P'S CHANGED. POWER RESETS IN D/P OK. FAULT IN C/D OR "003" COMMAND.
9. MULTIPLE FAULTS. RECOVERY TO DP FORMATTING UNLIKELY, BUT MAY ACHIEVE DECOM LOCK IN LSPE MODE.
10. PROBABLY OPEN CIRCUIT IN FORMATTING MODE CONTROL LINE. SYSTEM WILL OPERATE ONLY IN LSPE MODE.

DIAGNOSES.

EXIT POINT.

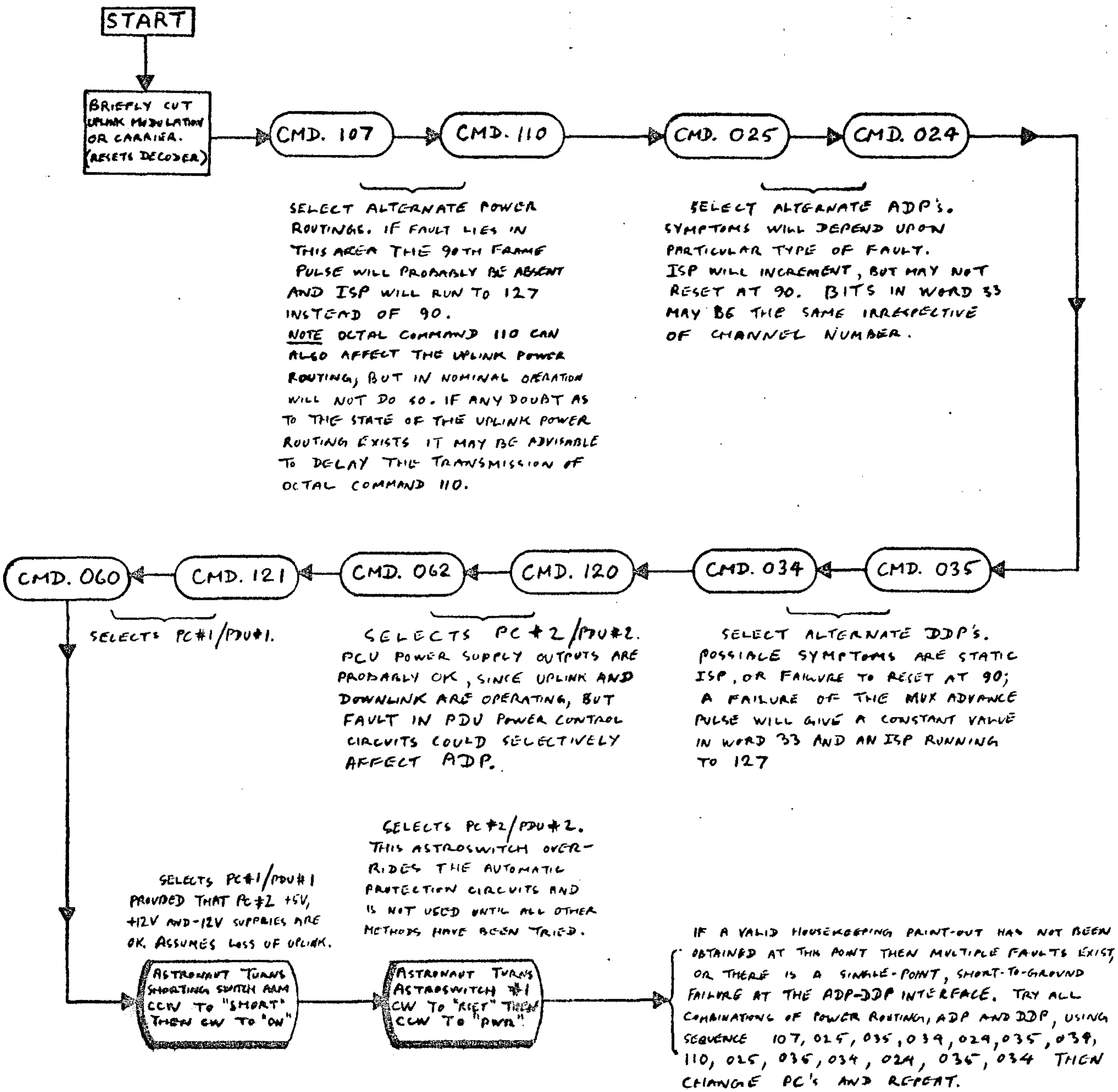
9. FAULT WAS IN D/P X.
10. SYSTEM WAS ALREADY IN D/P Y. D/P Y FAULTY.
11, 12, 13, 14. MULTIPLE C/D MODE AND BIT-RATE COMMAND FAULTS.
15. FAULT WAS IN D/P X FORMATTING CONTROL
16. SYSTEM WAS ALREADY IN D/P Y. FAULT IN D/P Y.
17, 18 FAULT IN C/D MODE CONTROL CIRCUITS.

AFTER ACHIEVING DECOM LOCK RETURN TO FIGURE 2.2-1(b).

CONTINGENCY PROCEDURE CP-04A :- DECOM LOCK OBTAINED BUT HOUSEKEEPING PRINT-OUT INVALID.

POSSIBLE CAUSES:-
- INCREMENTING SYNC PATTERN (ISP) NOT INCREMENTING CORRECTLY.
- MUX NOT STEPPING.
- FAULT IN ANALOG TO DIGITAL CONVERTER.
- FAULT IN PDU POWER SUPPLY CIRCUITS TO ADP.

NOTE :- THE FUNCTIONS OF THE DDP AND ADP IN THIS AREA ARE SO CLOSELY RELATED THAT EVEN A DETAILED ANALYSIS OF THE DIGITAL DATA IN WORD 33 WILL NOT REVEAL THE PRECISE LOCATION OF THE FAULT. THE PROCEDURE IS TO TRANSMIT A STANDARD SEQUENCE OF COMMANDS UNTIL THE FAULT DISAPPEARS, AND THEN TO ANALYZE THE RESULTS TO DETERMINE WHERE THE FAULT LAY.

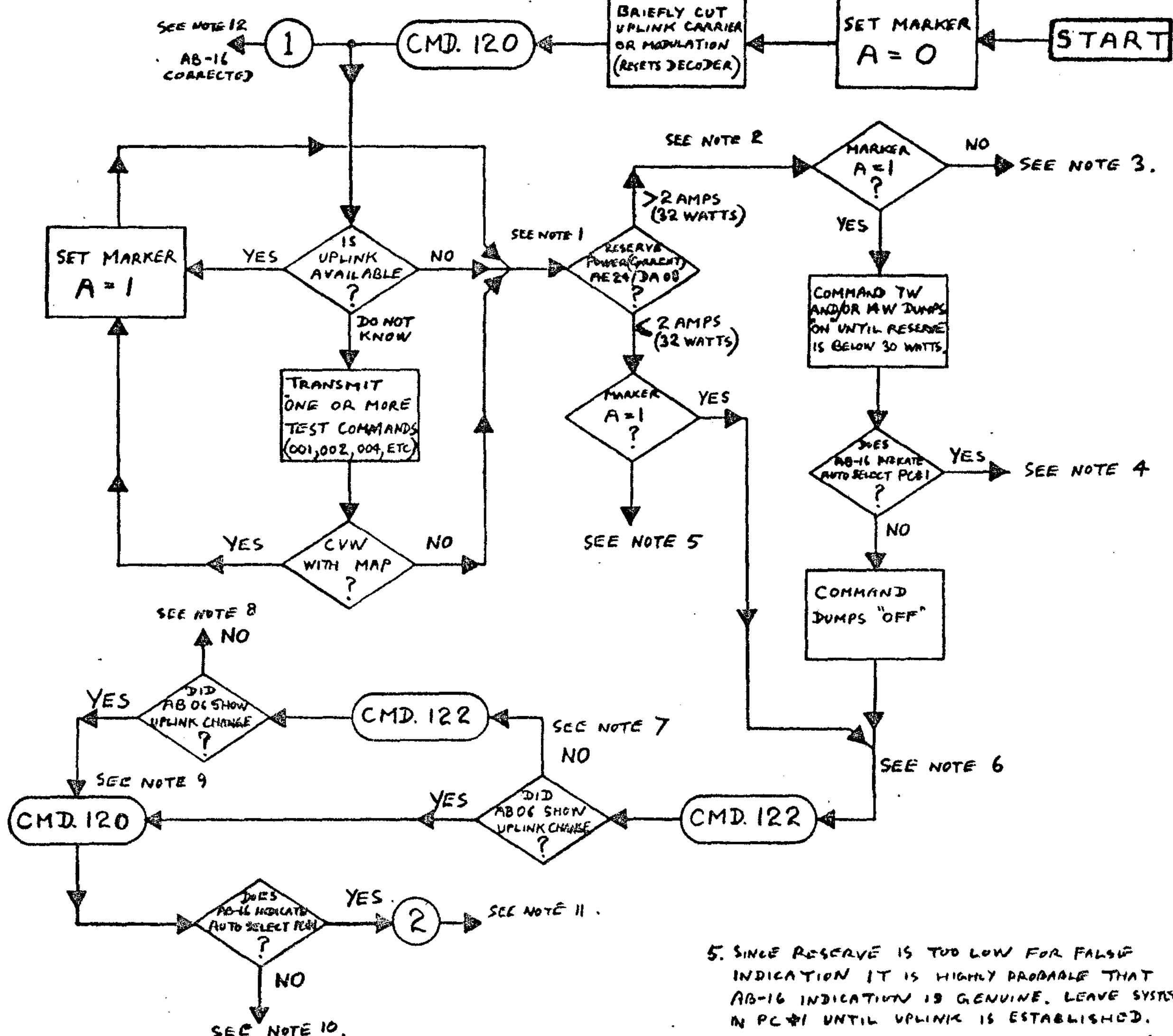


CONTINGENCY PROCEDURE CP-05 :- AB-16 DOES NOT INDICATE THAT AUTOSWITCH CIRCUIT IS SET TO SELECT PC #1, AND DOES NOT RESPOND TO OCTAL COMMAND 120.

POSSIBLE CAUSES :-
- RELAY IS INADVERTENTLY IN WRONG POSITION, TELEMETRY IS CORRECT, AND UPLINK IS NOT OPERATING.
- COMMAND DECODER FAULT PRODUCING A CONTINUOUS "AUTO SELECT PC#2" COMMAND.
- RELAY IS IN CORRECT POSITION, BUT HOUSEKEEPING CIRCUIT IS FAULTY, PROBABLY OPEN CIRCUIT.

NOTE :-
- IF AUTOSWITCH CIRCUIT CANNOT BE SET TO SELECT PC #1, THEN IT IS NOT PERMISSIBLE TO COMMAND A SWITCHOVER TO PC #2. ALL PC REDUNDANCY WOULD BE LOST AND OVERALL RELIABILITY REDUCED.
- RELAY IS PRESET BEFORE FLIGHT. NO ALSEP RELAY HAS MOVED IN TEST OR FLIGHT.

MARKER LOG		
A	O	



NOTES.

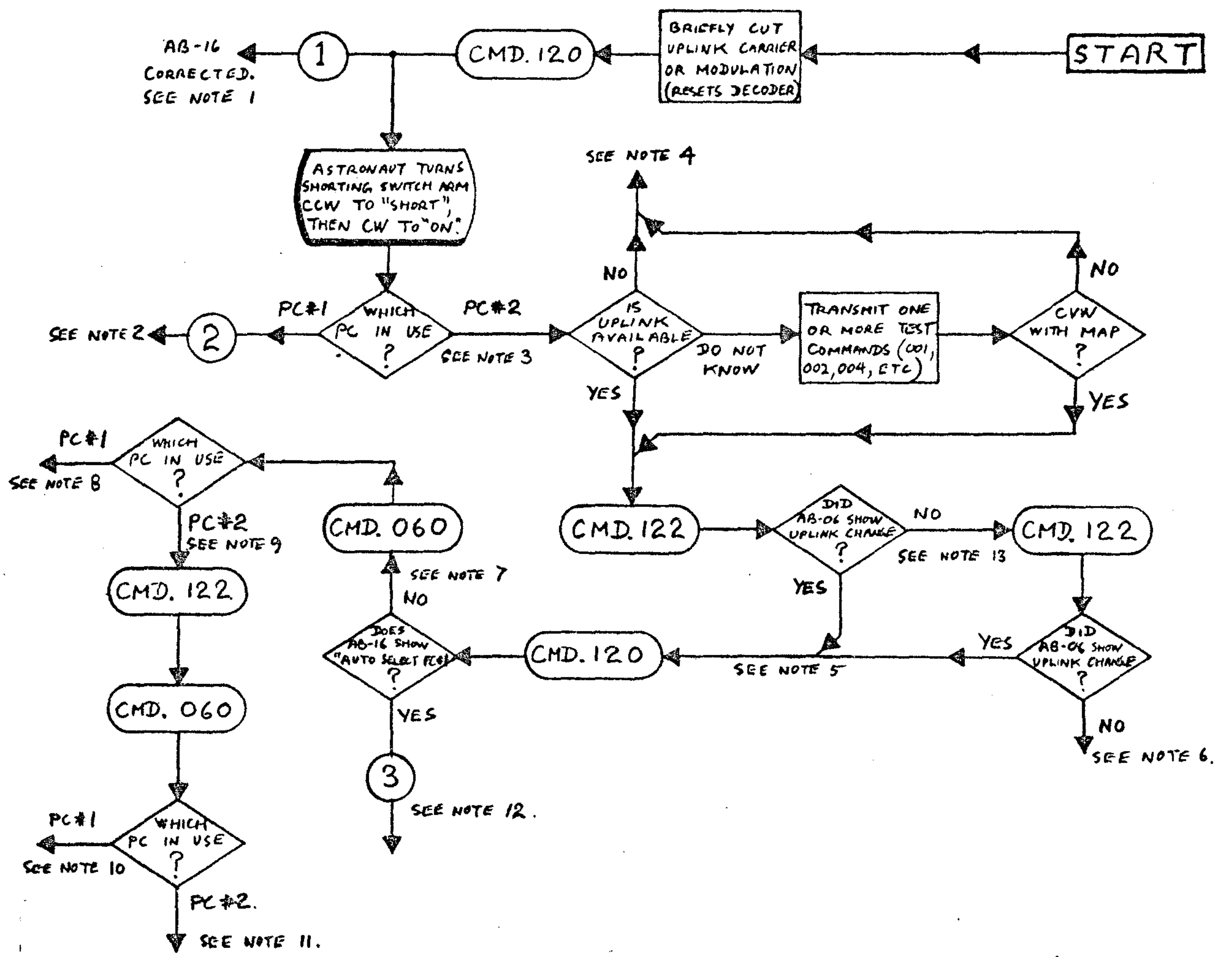
1. ASSUME INITIALLY THAT TELEMETRY IS AT FAULT. IF RELEVANT HOUSEKEEPING LINE IS OPEN CIRCUIT, THE ADP A-D CONVERTER WILL SEE A VOLTAGE SLIGHTLY LESS THAN THAT CORRESPONDING TO RESERVE CURRENT. IF RESERVE IS HIGH ENOUGH, AB-16 WILL SHOW "AUTO SELECT PC#2".
2. RESERVE IS HIGH ENOUGH FOR FALSE AB-16 INDICATION.
3. WITH NO UPLINK, SITUATION CANNOT BE RESOLVED. RECOMMENDATION:- AS LONG AS ASTRONAUT IS AVAILABLE TO SELECT PC#2 MANUALLY, LEAVE SYSTEM OPERATING IN PC#1, AND TRY TO ESTABLISH UPLINK (SEE CP-) IF UPLINK CANNOT BE ESTABLISHED, THEN WHOLE SYSTEM IS EFFECTIVELY DEAD.
4. FAULT EXISTS IN TELEMETRY CIRCUIT. AUTOSWITCH RELAY IS PROBABLY SET CORRECTLY. RECOMMENDATION :- FOLLOW NOMINAL PLAN AND SELECT PC#2.
5. SINCE RESERVE IS TOO LOW FOR FALSE INDICATION IT IS HIGHLY PROBABLE THAT AB-16 INDICATION IS GENUINE. LEAVE SYSTEM IN PC#1 UNTIL UPLINK IS ESTABLISHED.
6. HIGHLY PROBABLE THAT AB-16 INDICATION IS GENUINE. CHECK FOR COMMAND DECODER FAULT BY CHANGING UPLINKS.
7. UPLINK SWITCH FLIP-FLOP AND RELAYS MAY BE OUT OF STEP. TRY 122 AGAIN, AS SHOWN.
8. INDICATES POSSIBLE MULTIPLE FAULTS IN DECODER. LEAVE SYSTEM IN PC#1 UNTIL AUTOMATIC UPLINK CHANGE OCCURS, THEN REPEAT PROCEDURE.
9. COMMAND CAN NOW BE SENT VIA REDUNDANT DECODER.
10. MUST ASSUME THAT COMMAND LINE 121 IS SHORTED TO GROUND. DESIGNATE PC#1 AS PRIME.
11. (AND EXIT 2) ORIGINAL UPLINK IN USE WAS PRODUCING CONTINUOUS OCTAL 121 COMMAND, BUT CURRENT UPLINK IS OK. SWITCH TO PC#2 AS NORMAL BUT RESELECT PC#1 IF UPLINK IS CHANGED.
12. (AND EXIT 1) APPEARS TO HAVE BEEN MULTIPLE SCRAMBLING, INCLUDING UPLINK LOCK-OUT. CHECK ALL HK. IF NO FAULT INDICATIONS, SELECT PC#2 AS NORMAL.

RETURN TO FIG. 22-1(b)

CONTINGENCY PROCEDURE CP-06: SYSTEM IN PC #2, AB-16 INDICATES AUTOSELECT TO PC #2 AND DOES NOT RESPOND TO OCTAL COMMAND 120.

POSSIBLE CAUSES :-
- RELAY IS INADVERTENTLY IN WRONG POSITION, TELEMETRY IS CORRECT, AND UPLINK IS NOT OPERATING.
- COMMAND DECODER FAULT PRODUCING A CONTINUOUS "AUTO SELECT PC #2" COMMAND.
- RELAY IS IN CORRECT POSITION, BUT HOUSEKEEPING CIRCUIT IS FAULTY, PROBABLY OPEN CIRCUIT.

NOTE :-
- AUTOSWITCH CIRCUIT MUST BE SET TO SELECT REDUNDANT PC, OTHERWISE OVERALL RELIABILITY IS REDUCED.
- RELAYS ARE PRESET BEFORE FLIGHT, AND NO ALSEP RELAY HAS BEEN KNOWN TO MOVE IN TEST OR FLIGHT.



NOTES.

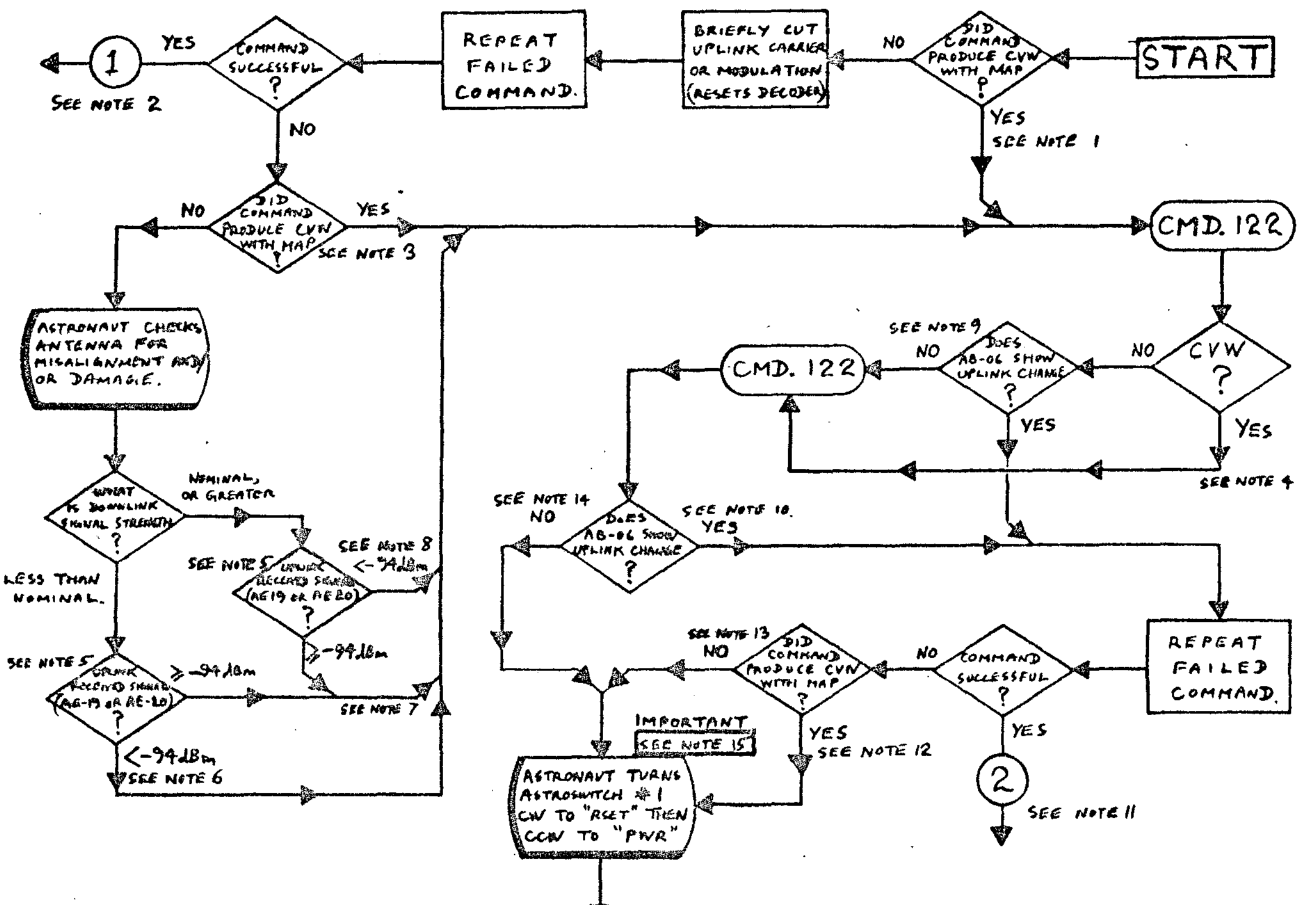
1. APPEARS TO HAVE BEEN MULTIPLE SCRAMBLING, PLUS UPLINK LOCK-OUT. CHECK ALL HK. IF NO FAULTS, PROCEED AS NORMAL.
2. AUTOSWITCH CIRCUIT IS SET CORRECTLY, AND IS OPERATING CORRECTLY. AB-16 TELEMETRY IS AT FAULT. COMMAND SYSTEM BACK TO PC #2 AND PROCEED AS NORMAL.
3. AB-16 INDICATION APPEARS TO BE CORRECT. TRY SWITCHING UPLINKS, IF POSSIBLE, AND COMMANDING 120 AGAIN.
4. SYSTEM MUST REMAIN IN UNPROTECTED STATE UNTIL AUTOMATIC UPLINK SWITCH OCCURS, THEN TRY AGAIN.
5. REDUNDANT COMMAND GATES IN USE. MAY CLEAR FAULT
6. APPARENTLY MULTIPLE COMMAND DECODER AND/OR PDU FAULTS. WAIT FOR AUTOMATIC UPLINK SWITCH.
7. COMMAND LINE 121 IS POSSIBLY SHORTED TO GROUND. AUTOSWITCH CIRCUIT PERMANENTLY LOCKED IN "AUTO SELECT TO PC #2". TRY TO SELECT PC#1 AS PRIME.
8. PROCEED AS NORMAL, BUT <u>DO NOT TRANSMIT OCTAL 062.</u> AUTOSWITCH PROTECTION SHOULD BE EFFECTIVE; (COULD BE VERIFIED BY OPERATING SHORTING SWITCH)
9. APPARENTLY MULTIPLE C/D/PDU FAULTS. TRY CHANGING BACK TO OTHER UPLINK TO FIND OPERATIONAL 060 COMMAND LINE.
10. MULTIPLE FAULTS CONFIRMED. SEE NOTE 8.
11. SYSTEM IS LOCKED IN UNPROTECTED STATE.
12. THIS IS REQUIRED NOMINAL STATUS. UPLINK ORIGINALLY IN USE APPEARS TO GIVE PERMANENT OCTAL COMMAND 121. PROCEED AS NORMAL, BUT IF CHANGE-BACK TO ORIGINAL UPLINK <u>MUST</u> BE MADE IT WOULD BE ADVISABLE TO CHANGE PC TO PC#1, AND AUTOSWITCH CIRCUIT TO "AUTO SELECT PC#2" BEFORE DOING SO.
13. UPLINK SWITCH FLIP-FLOP AND RELAYS MAY BE OUT OF STEP. TRY 122 AGAIN, AS SHOWN.

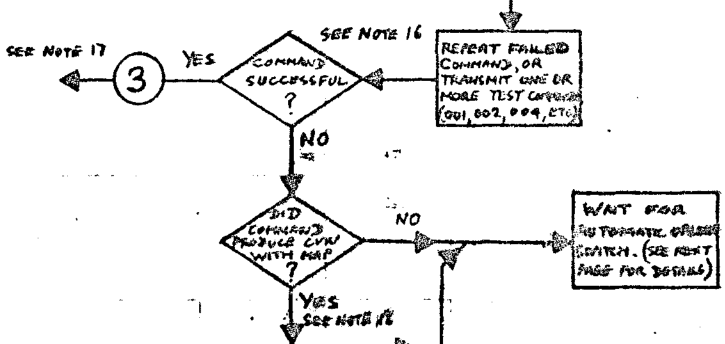
RETURN TO FIG. 22-1(b)

CONTINGENCY PROCEDURE CP-07:- FAILURE TO RESPOND TO COMMANDS I.E. PARTIAL OR COMPLETE LOSS OF UPLINK.

POSSIBLE CAUSES:-
- WEAK SIGNAL DUE TO C/S ANTENNA MISALIGNMENT OR DAMAGE, AND/OR C/S RF CIRCUIT DAMAGE.
- FAILED RECEIVER.
- FAILED COMMAND DECODER.
- FAULT ON ONE OR MORE COMMAND LINES.
- FAILURE IN RECEIVER AND/OR DECODER POWER CIRCUITS IN PDU.
- FAILURE IN CIRCUITS BEING COMMANDED.

NOTE:-
- IN NORMAL OPERATION THE FIRST COMMAND WHICH WILL BE TRANSMITTED IS OCTAL 062, "SELECT PC #2". IN THIS PARTICULAR CASE ONLY, SHOULD THE COMMAND FAIL, THE ASTRONAUT CAN OPERATE ASTROSWITCH A/S #1 TO SELECT PC #2 DIRECTLY. HOWEVER, IF CIRCUMSTANCES PERMIT, IT IS PREFERABLE (AND COMPLETELY SAFE) TO DELAY THIS MANUAL SELECTION UNTIL THE UPLINK SITUATION HAS BEEN INVESTIGATED FURTHER, OR, IF EARLIER, UNTIL THE ASTRONAUT MUST LEAVE THE ALSEP SITE.
- IF THE UPLINK APPEARS TO BE COMPLETELY INEFFECTIVE, THEN THE AUTOMATIC COUNTER CIRCUIT SHOULD SELECT THE REDUNDANT UPLINK, NOMINALLY AFTER 7.5 HOURS, BETWEEN THE FIRST AND SECOND EVA.





- FOR NOTES, SEE NEXT PAGE.
- WHEN SATISFACTORY COMMAND LINK ACHIEVED, RETURN TO FIG. 2.2-1(b).

CONTINGENCY PROCEDURE CP-07 (CONTD).

NOTES.

1. FAULT MUST BE IN DECODE GATES, COMMAND LINE, OR CIRCUIT BEING COMMANDED (INCLUDING INDIRECT EFFECT OF PDU FAULT)
2. UPLINK WAS TEMPORARILY LOCKED-OUT. CHECK SIGNAL STRENGTH.
3. UPLINK WAS TEMPORARILY LOCKED-OUT, BUT FAULT STILL EXISTS IN DECODE GATES, COMMAND LINE, OR CIRCUIT BEING COMMANDED. CHECK SIGNAL STRENGTH.
4. A CVW FOLLOWING A COMMAND OCTAL 122 IS A CERTAIN INDICATION THAT THE UPLINK HAS NOT SWITCHED, PROBABLY BECAUSE THE COMMAND ROUTING FLIP-FLOP WAS OUT OF STEP WITH THE UPLINK RELAYS IN THE PDU. A SECOND OCTAL 122 SHOULD BE EFFECTIVE, IF NO FAULTS EXIST.
5. THE RECEIVER SIGNAL STRENGTH TELEMETRY IS TEMPERATURE DEPENDENT. BE CAREFUL TO SELECT THE CURVE CORRESPONDING MOST CLOSELY TO THE TEMPERATURE INDICATED BY AT-04, OR CS-37, OR AT-40 (RECEIVER A ONLY).
6. SINCE BOTH UPLINK AND DOWNLINK HAVE LOWER THAN NOMINAL SIGNAL STRENGTHS A COMMON FAULT PROBABLY EXISTS IN THE RF LINK. ALTHOUGH IT IS UNLIKELY TO IMPROVE THE UPLINK PERFORMANCE THERE IS NOTHING TO BE LOST BY FOLLOWING THE REMAINDER OF THE PROCEDURE. IF POSSIBLE, INCREASE UPLINK ERP; TESTS HAVE SHOWN THAT RESPONSE TO COMMANDS IS UNLIKELY IF SIGNAL STRENGTH IS LESS THAN −94 dBm.
7. SIGNAL STRENGTHS ABOVE −94 dBm SHOW THAT RF LINK THROUGH THE FINAL DETECTOR OF RECEIVER IS SATISFACTORY.
8. LOW RECEIVER SIGNAL, IN ASSOCIATION WITH NOMINAL OR BETTER DOWNLINK SIGNAL, SUGGESTS THAT FAULT IS IN DIPLEXER FILTER, POWER SPLITTER OR RECEIVER. RESPONSE TO COMMANDS IS UNLIKELY BELOW −94 dBm.
9. IF THE ROUTING FLIP/FLOP AND THE UPLINK POWER RELAYS ARE OUT OF STEP, THEN THE FIRST 122 COMMAND WILL BE INEFFECTIVE. NORMALLY, IF A SWITCH DOES NOT OCCUR, A CVW WILL BE RECEIVED.
10. COMMAND ROUTING FLIP-FLOP AND UPLINK POWER RELAYS WERE OUT OF STEP. PREVIOUS UPLINK AT LEAST PARTLY OPERABLE.
11. FAULT WAS IN COMMAND OUTPUT GATES OF THE PREVIOUS UPLINK.
12. FAULT MUST BE ON COMMON COMMAND LINE, IN THE CIRCUIT BEING COMMANDED, OR IN THE POWER SUPPLY TO THAT CIRCUIT. SWITCHING PC MAY RECTIFY FAULT, BUT FURTHER SWITCHING OF UPLINKS WILL NOT.
13. IT APPEARS THAT SYSTEM HAS BEEN SWITCHED TO A DEAD UPLINK. MAY POSSIBLY BE A POWER CIRCUIT FAULT IN PDU, IN WHICH CASE SWITCHING PC'S MAY HELP. OTHERWISE MUST WAIT FOR AUTOMATIC UPLINK SWITCH, BACK TO ORIGINAL UPLINK.
14. MULTIPLE FAULTS EXIST IN THE COMMAND DECODER OR THE PDU. SWITCHING PC'S WILL HELP IN THE LATTER CASE, OTHERWISE MUST WAIT FOR AUTOMATIC UPLINK SWITCH.
15. ASTROSWITCH #1 OVERRIDES THE AUTOMATIC PC FAILURE PROTECTION CIRCUITS. IF PC#2 HAS FAILED THEN ARRAY E WILL FAIL COMPLETELY AND PERMANENTLY AT THIS POINT. IF POSSIBLE DELAY THIS OPERATION UNTIL AFTER THE AUTOMATIC UPLINK SWITCH. IT IS POSSIBLE THAT THE FAILURE TO BE COMMANDED TO PC#2 MAY BE DUE TO THE VALID ACTION OF THE AUTOMATIC PROTECTION CIRCUIT. IF OTHER COMMANDS PRODUCE CVW BUT OCTAL 062 DOES NOT, AND THE SYSTEM REMAINS IN PC#1, THEN PC#2 MAY HAVE FAILED. IT IS PREFERABLE TO COMMAND A CHANGE TO PC #2 VIA THE UPLINK. IF SYSTEM IS IN PC#2 AND A SWITCH BACK TO PC#1 IS REQUIRED, AND IT CANNOT BE COMMANDED, THEN ASTRONAUT SHOULD BRIEFLY SET SHORTING SWITCH TO "SHORT"
16. TEST COMMANDS DO NOT TEST OUTPUT GATES OR LINES
17. POSSIBLY BOTH UPLINKS WILL NOW BE SATISFACTORY. FAULT WAS IN PCU/PDU.
18. PROBABILITY OF RESPONSE TO FAILED COMMAND IS NOW VERY LOW, BUT CHANGE TO FINAL PCU/PDU/UPLINK COMBINATION MAY HELP.

AUTOMATIC UPLINK SWITCH.

T_0 = TIME OF APPLICATION OF POWER TO ARRAY E. (OPERATION OF A/S #1 OR THE SHORTING SWITCH RESETS T_0)

THE TIME AT WHICH THE FIRST UPLINK SWITCH WILL OCCUR DEPENDS UPON THE DOWNLINK BIT RATE, THE INITIAL STATE OF THE "DELAY/ENABLE" FLIP-FLOP, AND THE INITIAL STATES OF THE COMMAND ROUTING FLIP-FLOP AND THE UPLINK POWER RELAYS, AS SHOWN IN THE TABLE BELOW:-

AB-18 UPLINK SWITCH DELAY/ENABLE FLIP-FLOP STATUS	RELATIVE STATES OF COMMAND ROUTING FLIP-FLOP AND RELAYS	DOWNLINK BIT RATE.	
		1060 BPS OR 3533 BPS	530 BPS.
ENABLED *	IN STEP *	T_0+7h.38m.43s±30s	T_0+15h.17m.26s±60s
ENABLED	OUT OF STEP	T_0+69h.28m.16s±52s	T_0+138h.56m.36s±1m.44s
DELAYED	IN STEP	(same as above)	(same as above)
DELAYED	OUT OF STEP	T_0+131h.17m.53s±1m.14s	T_0+262h.36m.46s±2m.28s
THEN AT INTERVALS OF		61h. 49m.35s±22s	123h. 39m. 10s±44s

* NOMINAL TURN-ON CONDITIONS.

CONTINGENCY PROCEDURE CP-08: AB-18 Indicates That Next Automatic Uplink Switch is "Enabled", With No Response to Octal Command 174.

1. Comments Upon Possible Causes:

a) Failure in telemetry circuit: Operations of the autoswitch circuit, and its response to commands, will be normal, but the telemetry indications will be false. Once this has been established, system can be operated normally, ignoring AB-18 telemetry.

b) Failure in Octal Command 174 decode gates in uplink in use: This fault can be corrected by selecting the redundant uplink.

c) Open circuit in common Octal Command 174 line: The facility to delay the uplink switch will be lost permanently; the redundant uplinks will be selected alternately at regular intervals. Provided that both uplinks are serviceable and that the system is operating in the Data Processor formatting mode there should be no adverse affects. If the system is operating in the LSP formatting mode it will automatically revert to the Data Processor formatting mode as the uplinks change over. The times at which the switches will occur can be predicted fairly accurately; in particular, following nominal time-lines, an automatic switch-over will not occur during the periods of listening for the detonations of the LSPE explosive packages.

d) Failure in "Enabled/Delayed" flip-flop, leaving switch-over permanently enabled: The results and comments are the same as in (c).

e) Failure in power-reset circuit, causing permanent "Enable" condition: Depending upon the point at which the power reset circuit has failed, the result may be identical with that in (c), or the counter circuit may be paralyzed, giving no automatic uplink switch-over and no periodic commands. In the latter case, a commanded switch to the redundant uplink is a potentially hazardous operation; if the redundant uplink has failed, then effectively the whole of Array E will have failed. Supporting evidence for an extensive power-reset failure is that the ripple-off circuit will also be paralyzed.

f) Partial loss of +5 volt supply to the autoswitch circuit: This is theoretically possible, but of low probability. It requires that the telemetry buffer amplifier remains powered, while some or all of the remaining circuits are unpowered. If this occurs, it is possible that the counter and autoswitch circuits may cease to function, making a ground-commanded switch to the redundant uplink potentially hazardous.

2. Recommended Procedures

2.1 Continue as normal with other operations.

2.2 At approximately 7.5 hours after turn-on, note whether uplink changes automatically. (This assumes normal down-link bit-rate and normal initialization; see table at end of CP-07 for exact periods corresponding to other initial conditions and bit rates.)

2.3 If uplink does switch, transmit Octal Command 174. If AB-18 changes to "Delayed" then fault (b) exists; maintain current uplink configuration by transmitting 174 at regular intervals. If AB-18 does not change then fault (c), (d), (e) or (f) exists; it is unlikely that the periodic switching of uplinks can be suppressed - see comments for (c).

2.4 If uplink does not switch, then either fault (a), (e) or (f) exists, or one of the off-nominal cases in the table at the end of CP-07 applies, with a correspondingly later switch-over.

2.4.1 At approximately 23 hours after turn-on the operation of the autoswitch counter can be verified by temporarily turning LEAM power "ON" for about 15 minutes, enabling the periodic commands, and noting whether the automatic calibrations occur. If they do occur, then it is unlikely that faults (e) and (f) are present. If the automatic calibrations do not occur then it is highly likely that either fault (e) or fault (f) is present and a commanded switch to the other uplink should be avoided if at all possible.

2.4.2 Transmit Octal Command 174 at regular intervals. If an automatic uplink switch occurs at or about any of the times listed in the table at the end of CP-07, suspect that the initialization and/or bit-rate was off-nominal, then refer to 2.3 above. (If an automatic switch occurs at a time which appears to be completely unrelated to the automatic timer periods, suspect a possible circuit-breaker switch-over, then refer to 2.3 above.) If after the maximum period in the table in CP-07 no switch-over has occurred, and if the periodic commands are being generated correctly, the most probable explanation is that the telemetry circuit AB-18 has failed (see (a)).

CONTINGENCY PROCEDURE CP-09: After Executing Octal Command 057 During Central Station Initialization AB-11 Does Not Change Status Or AB-11 Initiates In The "OFF" Status Or the "ON" Status.

1. The LSPE power circuits are flown latched in the "Standby" condition, in order to provide a safe means of verifying correct control and operation of the LSPE power relays and telemetry circuit. Without this verification it is possible, though not very probable, that the LSPE transmitter could be operating while the astronauts are deploying the explosive packages, or while data is being gathered from the other experiments. During test it was observed that the LSPE transmissions could produce false outputs from LEAM.

2. Procedure

2.1 ASE shall advise the Flight Director of the uncertainty as to the control and/or current status of the LSPE electronics, and shall request the crew to turn Astroswitch #2 counterclockwise (CCW), to "DSBL", in order to inhibit operation of the LSPE during troubleshooting.

2.2 As Astroswitch #2 is set to "DSBL", note from the housekeeping print-out whether there is a change in reserve power. An increase of reserve power by approximately 5 to 6 watts is a certain indication that the LSPE electronics were "ON", whatever AB-11 may be indicating.

2.3 Transmit the following Octal Command sequence, noting the corresponding changes in AB-11, if any:

057	LSPE Power Off
055	LSPE Power On
056	LSPE Power Standby
057	LSPE Power Off

(There will be no corresponding changes in reserve power because A/S #2 is open.)

2.3.1 If the telemetry is numerically within the AB-11 bands given in ALSEP-SE-33/BSR-3059, and remains constant throughout, then it is possible that the decode gates in the Command Decoder in use, or the common command line(s), or the PDU circuits in use, are at fault, locking the LSPE in a particular power status. If the telemetry persistently indicates "OFF", with a zero or low numerical value, then it is also possible that a short-to-ground type failure exists in the telemetry circuit.

Select the redundant uplink, by transmitting Octal Command 122, then repeat the sequence in 2.3.

2.3.1 (Cont.)

If there is no improvement, select the redundant PC/PDU by transmitting Octal Commands 120 and 062, or 121 and 060, as appropriate, then repeat the sequence in 2.3. (Note: It is preferable not to use Astroswitch #1 to select PC #2 unless the uplinked command is ineffective, since A/S #1 inhibits the automatic protection circuits.)

If there is still no improvement, then either the telemetry fault exists, or one or more of the common command lines have failed and ground control of the LSPE power has been permanently lost. To resolve this problem it is necessary to apply power to the LSPE electronics, as described in 2.4 below.

2.3.2 If the telemetry values are not in agreement numerically with SE-33, but do show three distinct levels as the power commands are transmitted, it is highly probable that the fault is in the telemetry circuits only. See 2.4 below.

2.3.3 If the telemetry reads correctly for LSPE Power "ON" but reads "OFF" for both "STANDBY" and "OFF", it is probable that the LSPE power can be satisfactorily controlled. See 2.4 below.

2.3.4 If the telemetry is constant, at a numerical value which is above any valid AB-11 band given in SE-33, and only a few bits below the numerical value of the reserve power telemetry, then it is almost certain that the telemetry line from the LSPE power relays is open circuit. See 2.4 below.

2.4 If the problem cannot be resolved with Astroswitch #2 at "DSBL" then control of the LSPE power circuits may be verified as follows, with relatively low risk:

2.4.1 Verify that the system is in the Data Processor formatting mode, in either Normal or Slow bit-rate. Under these conditions the explosive package circuits cannot recognize the firing code, even if the LSPE transmitter is operating and the receiver units are powered.

2.4.2 Request the crew to turn Astroswitch #2 clockwise (CW) to "ENBL".

2.4.3 Note any change of reserve power. A reduction of 5 to 6 watts indicates that the LSPE electronics are powered.

2.4.4 Transmit Octal Command 162, "LSPE Transmitter Pulses Off". (Note that a power reset circuit in LSPE should initialize in the "pulses off" status.

2.4.5 Repeat the sequence of commands given in 2.3, noting the corresponding changes in reserve power, if any. Changes of approximately 5 to 6 watts following any command to or from the LSPE Power On status are a certain indication that adequate control of the LSPE power circuits is available.

2.4.6 If no changes in reserve power are observed then the sequence may be repeated after switching uplinks, then PC's. However, in view of the previous switches at 2.3.1 it is unlikely that any improvement will result.

2.5 If by this stage control of the LSPE power circuits has not been established, then it is highly improbable that control will be established at any time in the future.

2.5.1 If the LSPE is locked in a power-off state then there is little point in deploying the explosive packages or the geophones.

2.5.2 If the LSPE is locked in a power-on state the experiment could be permanently disabled by setting Astroswitch # 2 back to "DSBL". However, this is not recommended for consideration unless:

a) it is not possible to command the LSPE transmitter pulses off.

and/or

b) the RTG output power (CS-35 or CS-36) is less than 68 watts.

There is no direct monitoring of the LSPE transmitter pulses, but if the system is commanded to the LSPE formatting mode the status bits in the LSPE format can be examined. If the very slight risk is acceptable, the pulses could be commanded "ON" and "OFF" (Octal Command 156 and 162) noting the change in the transmitter status bits and possibly the slight change in reserve power. It is also possible that the crew would hear the 40 watt LSPE AGC pulses through their headsets, as clicks at 6Hz, but this has not been confirmed by test.

With regard to the power and thermal budgets, the Central Station design case includes LSPE "ON" at lunar noon, while at night the power in LSPE is removed from the regulator/heater resistors but still appears as heat inside the Central Station. At 68 watts there is sufficient power to keep all experiments, including LSPE, operating.

CONTINGENCY PROCEDURE CP-10: UNABLE TO COMMAND SYSTEM TO LSPE FORMATTING MODE.

1. Possible Causes:

Downlink bit-rate 530 or 1060 BPS

- Fault in Octal Command 003 or 005 decode gates in uplink in use.
- Fault in formatting mode flip-flop in uplink in use.
- Short-to-ground on common formatting mode control line from C/D to D/P.
- Fault in formatting mode and/or bit-rate selection circuits in DDP in use.

Downlink bit-rate 3533 BPS

- Fault in transmitter modulation circuit in DDP in use.
- Open-circuit in digital data line from LSPE to DDP
- Fault in LSPE, e.g. not powered, Barker Code generation failed, formatting circuits failed, etc.

2. Procedures

2.1 Bit-Rate 530 or 1060 BPS

Transmit the following sequence of Octal Commands, pausing as shown to determine whether the bit rate has changed to 3533 BPS.

2.1 Bit-Rate 530 or 1060 BPS (Cont.)

006, Pause	.	System possibly in slow bit rate.
035,003,006,Pause	.	Select DDP 'Y'. 003 and 006 should not be necessary if fault existed in DDP 'X' only.
034,003,006,Pause	.	Selects DDP 'X'.
122,003,006,Pause	.	Changes uplink if uplink switch flip-flop and relays correctly in step. 003 is necessary because an uplink change automatically causes reversion to DDP formatting mode. 006 may not be necessary, but does no harm.
122,003,006,Pause	.	Repeat of previous sequence to cover case when uplink switch flip-flop and relays were initially out of step.

If the bit-rate has not changed to 3533 BPS by this point, then it must be assumed that the prime LSPE mode of operation has been lost permanently.

Changing the ground station decom format to LSPE Slow will determine whether the fault lies in the bit-rate or the formatting mode area.

2.2 Bit-Rate 3533 BPS, No Decom Lock

2.2.1 Verify that LSPE power is "ON". Refer to AB-11 and Reserve Power change in last DP Formatting Mode print-out. If necessary, revert to DP Formatting Mode by transmitting Octal Command 005, then refer to CP-09.

2.2.2 Switch to redundant DDP by transmitting Octal Command 035, Select DDP 'Y', or Octal Command 034, Select DDP 'X', as appropriate.

2.2.3 Examine downlink bit-stream. If it is unchanging, i.e., all 1's or all 0's, then the fault is almost certainly not correctable, and the LSPE is lost permanently.

If the downlink bit-stream is obviously a changing pattern of 1's and 0's, try reducing the Barker Code recognition requirements.

2.2.4 Examine downlink signal strength. Is it sufficient to ensure a low enough bit error rate to allow recognition of a reduced Barker Code with reasonable certainty? If not, try the effect of switching transmitters, using Octal Command 013 and 015 if currently in Transmitter A, or Octal Commands 014 and 012 if currently in Transmitter B. If available, use a larger ground antenna.

2.2 Bit-Rate 3533 BPS, No Decom Lock (Cont.)

2.2.5 If by this point decom lock has not been achieved, then it is unlikely that any short-term solution will be found. Off-line analysis of the down-link bit-stream may reveal the fault and allow some or all of the data to be recovered. It is recommended that if:

(a) the 3533 BPS bit-rate is established

and

(b) the bit-stream contains a varying pattern of 1's and 0's which could conceivably be data.

then consideration should be given to 'blind' operation of the LSPE experiment during the predicted explosion periods. Operation at 3533 BPS is essential, since the explosive package circuits cannot recognize the firing pulses at 1060 BPS.

CONTINGENCY PROCEDURE CP-11: Unable to Command System From LSPE Formatting Mode To Data Processor Formatting Mode

1. Possible Causes:

- Fault in Octal Command 003 or 005 decode gates in uplink in use.
- Fault in formatting mode flip-flop in uplink in use.
- Open-circuit in common formatting mode control line from C/D to D/P
- Fault in formatting mode and/or bit-rate selection circuits in DDP in use.

2. Procedure

2.1 Transmit following sequence of Octal Commands, pausing as shown to determine whether decom lock in DP Formatting Mode can be achieved:

006, Pause	. May be in slow bit rate.
035,005,006, Pause	. Selects DDP 'Y'. Commands 005 and 006 should not be necessary if fault existed only in DDP 'X'
034,005,006, Pause	. Selects DDP 'X'
122,005,006, Pause	. Switches uplinks provided that uplink switch flip-flop and relays were in step. Commands 005 and 006 should not be necessary if fault existed only in original uplink.

2. Procedure

2.1 (Cont.)

122,005,006,Pause . Ensures that an uplink switch will be obtained even if the flip-flop and relays were initially out of step.

If by this point the Data Processor formatting mode has not been obtained, then it is highly unlikely that it can be; the system will probably remain locked in the LSPE formatting mode permanently. However, see 2.2 and 2.3.

2.2 If a particular group of faults exist in the system, it is possible, but improbable, that the system can be recovered to the Data Processor formatting mode by switching PC's.

2.3 Since the system is in the LSPE formatting mode there can be no direct verification that the uplinks actually switched when commanded to do so. Multiple faults in the decode gates in the uplink in use could simultaneously hold the system in the LSPE formatting mode and block a commanded uplink switch. An automatic uplink switch should occur as defined in the table at the end of CP-07, and this may allow reversion to the Data Processor formatting mode.

CONTINGENCY PROCEDURE CP-12: LEAM TEMPERATURE LOW

MARKER LOG.

A	0	
B	0	

GENERAL NOTES.

1. HEATER CIRCUIT SHOULD INITIALIZE AUTOMATICALLY IN 'AUTO' CONDITION.
2. SUCCESSIVE 117 COMMANDS WILL CYCLE HEATERS THROUGH SEQUENCE OFF-AUTO-ON-OFF-AUTO-ON... AND SO ON.

SPECIFIC NOTES.

1. HEATER MAY HAVE FAILED TO INITIALIZE CORRECTLY.
2. IF A=1 THEN 'AUTO' OR 'ON' CIRCUIT HAS FAILED.
3. SYSTEM IS IN COMMANDED 'ON' STATE. PROBABLY NO HEATER CONTROL FAULTS EXIST.
4. IF A=1 THEN 'AUTO' OR 'ON' CIRCUIT HAS FAILED, AND PROBABLY THE POWER RELAY TO 'AUTO' AS WELL.

   IF B=1 THEN PROBABLY THE 'ON' CIRCUIT HAS FAILED.
5. MULTIPLE FAULTS EXIST.
6. SYSTEM SET TO 'STANDBY'.

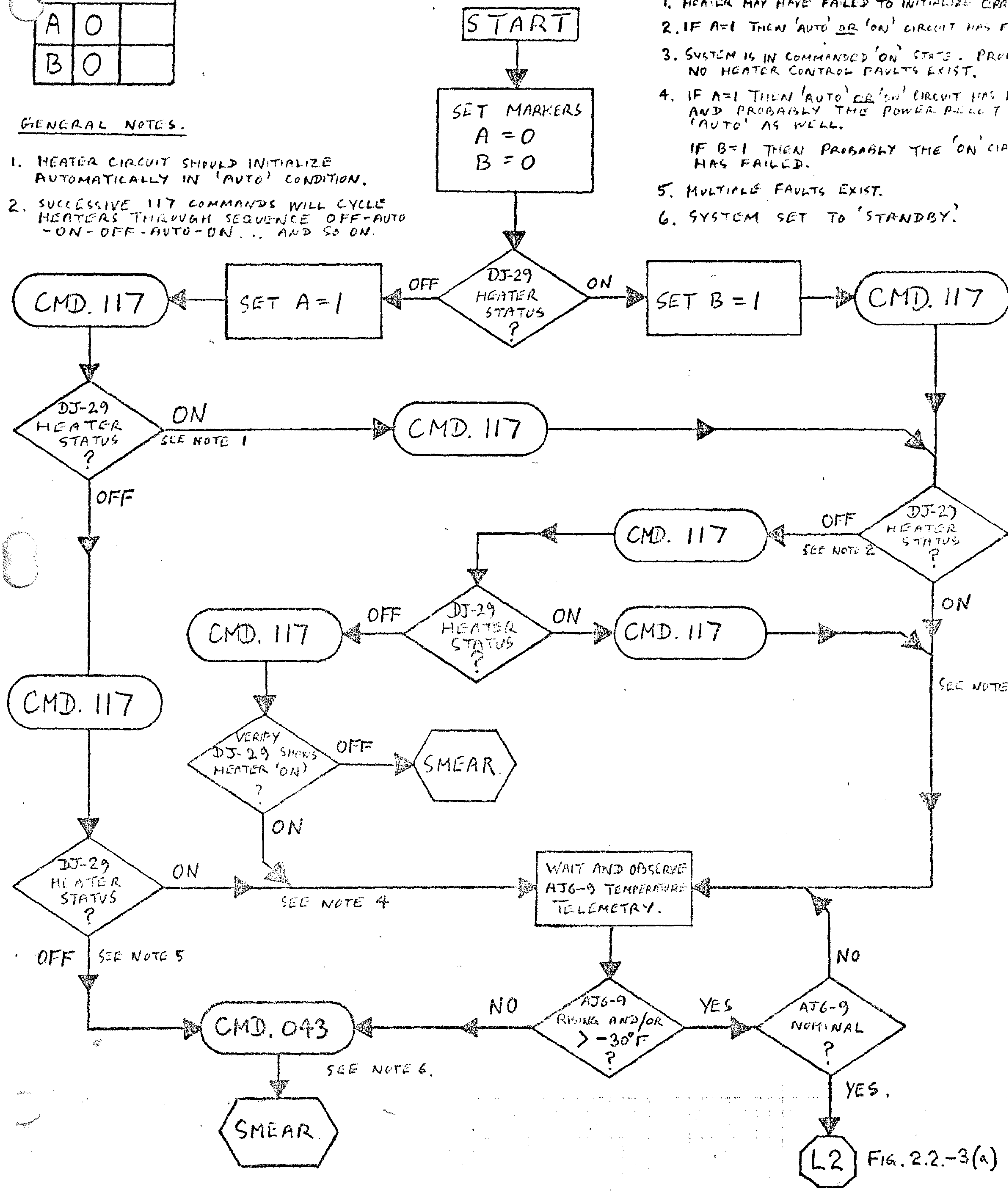


FIG. 2.2.-3(a)

CONTINGENCY PROCEDURE CP-13: LEAM TEMPERATURE HIGH

GENERAL NOTES.

1. HEATER CIRCUIT SHOULD INITIALIZE AUTOMATICALLY IN 'AUTO' CONDITION.
2. SUCCESSIVE 117 COMMANDS WILL CYCLE HEATERS THROUGH SEQUENCE OFF-AUTO -ON-OFF-AUTO-ON.... AND SO ON.

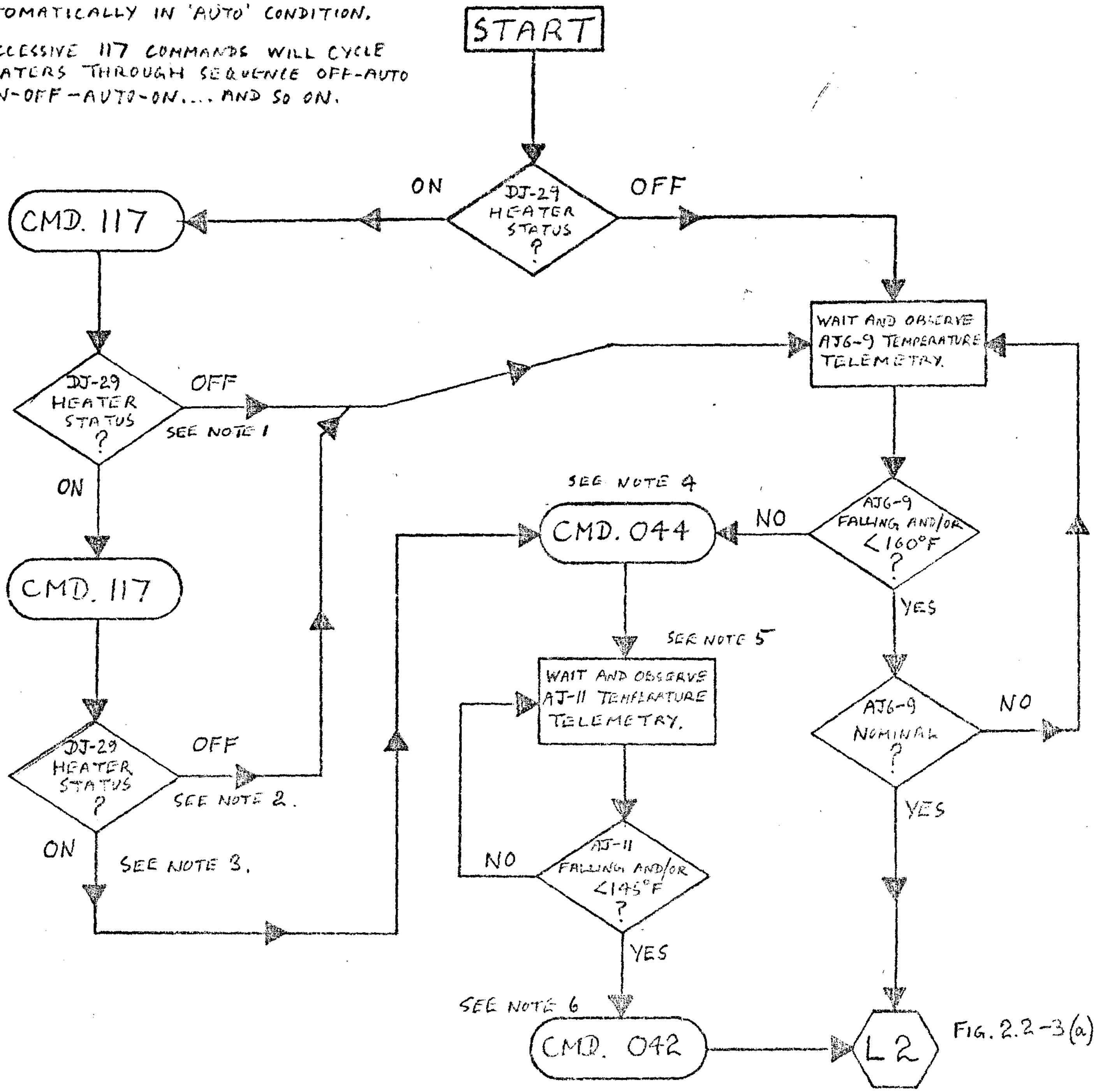


FIG. 2.2-3(a)

SPECIFIC NOTES.

1. HEATER MAY HAVE FAILED TO INITIALIZE CORRECTLY.
2. AUTO HEATER CONTROL HAD PROBABLY FAILED IN 'ON' STATE.
3. EXTENSIVE HEATER CONTROL CIRCUIT FAILURE OR POSSIBLY FAILURE OF COMMAND LINK. CONSIDER COMMANDING A SWITCHOVER TO THE REDUNDANT UPLINK.
4. COMMANDS LEAM POWER 'OFF'.
5. AJ-11 TEMPERATURE TELEMETRY IS AVAILABLE INDEPENDENTLY OF LEAM POWER STATUS.
6. COMMANDS LEAM OPERATE POWER 'ON'.