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2-5-1968

### Guidance and Control System (GC) - Malfunction Procedures for Guidance and Navigation (GN) and Malfunction Procedure Symptoms Tables

National Aeronautics and Space Administration (NASA)

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#### Recommended Citation

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1968

Jack Swigert

This has been incorporated  
in the recent changes  
"Steps 11 and 12 of GEN  
Proc #7 have been  
deleted."

June 6, 1968

NOTE OF INTEREST - AS-205/101

Two items of interest concerning the Temp Caution which occurred during the AS-205 sims on May 28, 1968:

1. The astronaut malfunction procedures indicate that the reset button on the DSKY should be pressed in an attempt to clear the indication. This is erroneous since the reset button will not clear the Temp Caution indication. The only thing, aside from an additional malfunction, which will clear this indication is a return to normal of the IMU Temp Within Limits signal.
2. The G&N System is designed such that IMU Temperature Within Limits signal is wired directly to an "or" gate in the CMC, the other input to the gate being Channel 11 bit 4 set. The output of the "or" gate controls the DSKY relay circuit which operates the Temp Caution light. This means that either the Temp Out of Limits (inverse of Temp Within Limits, a logic "1") or Channel 11 bit 4 set will cause the light to come on. This was not the case in the sim of May 28. It appears that the CMS is configured so that only Channel 11 bit 4 operates the Temp Caution.

R. A. Precourt  
Richard A. Precourt

FC35:RAPrecourt:san

Reed

R

Jack,  
check out →  
and this, →  
Thank Walt

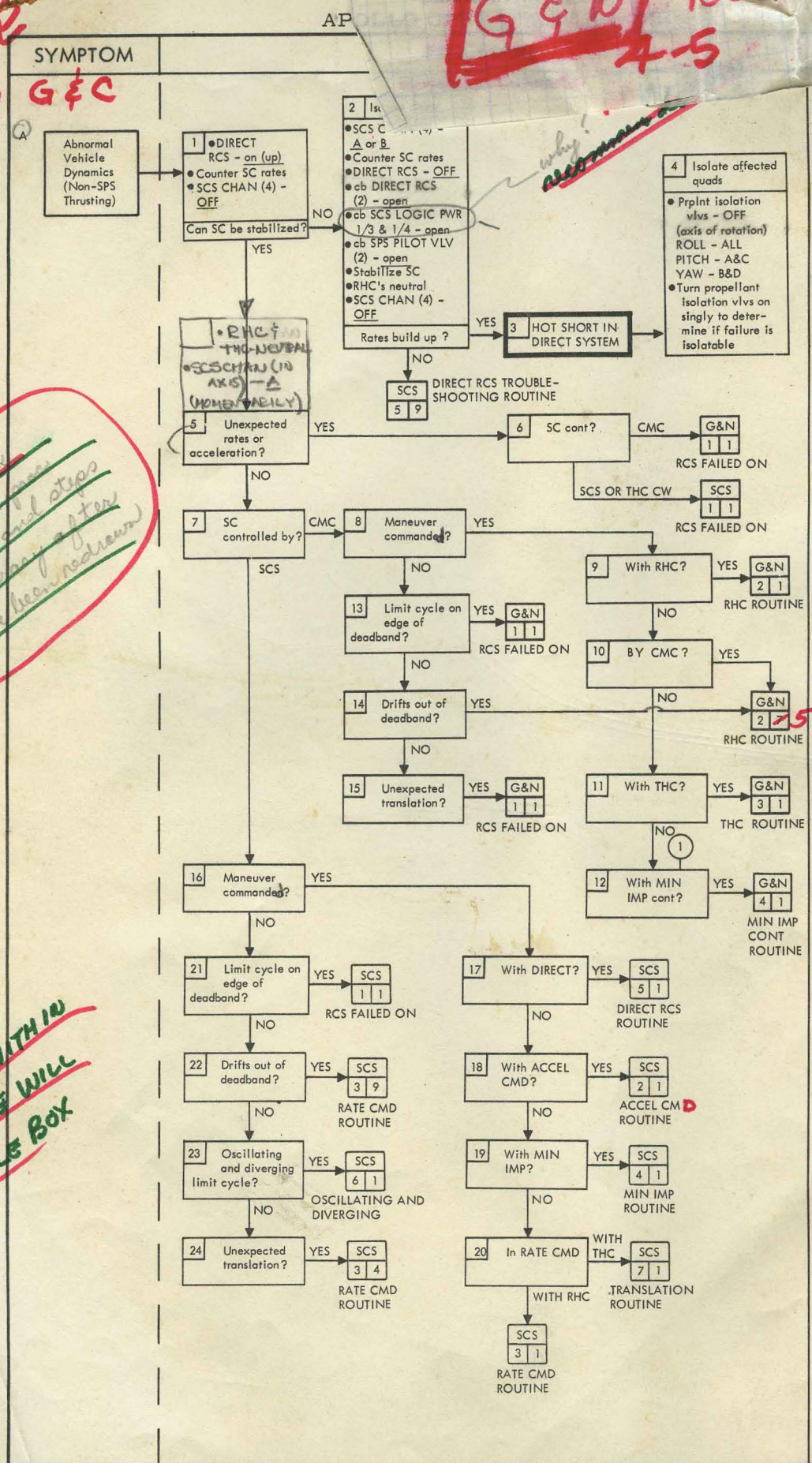


UPDATE  
G&C

**G&N**  
4-5

READY TO GO!

G&C  
MALFUNCTION



OK 4-5

Layout on but check steps numbers and steps for accuracy after all have been redrawn

LIGHTS WITH IN PROCEDURE WILL BE SINGLE BOX

# edge because of deletion & edge up 4-5 to flow # 2.88

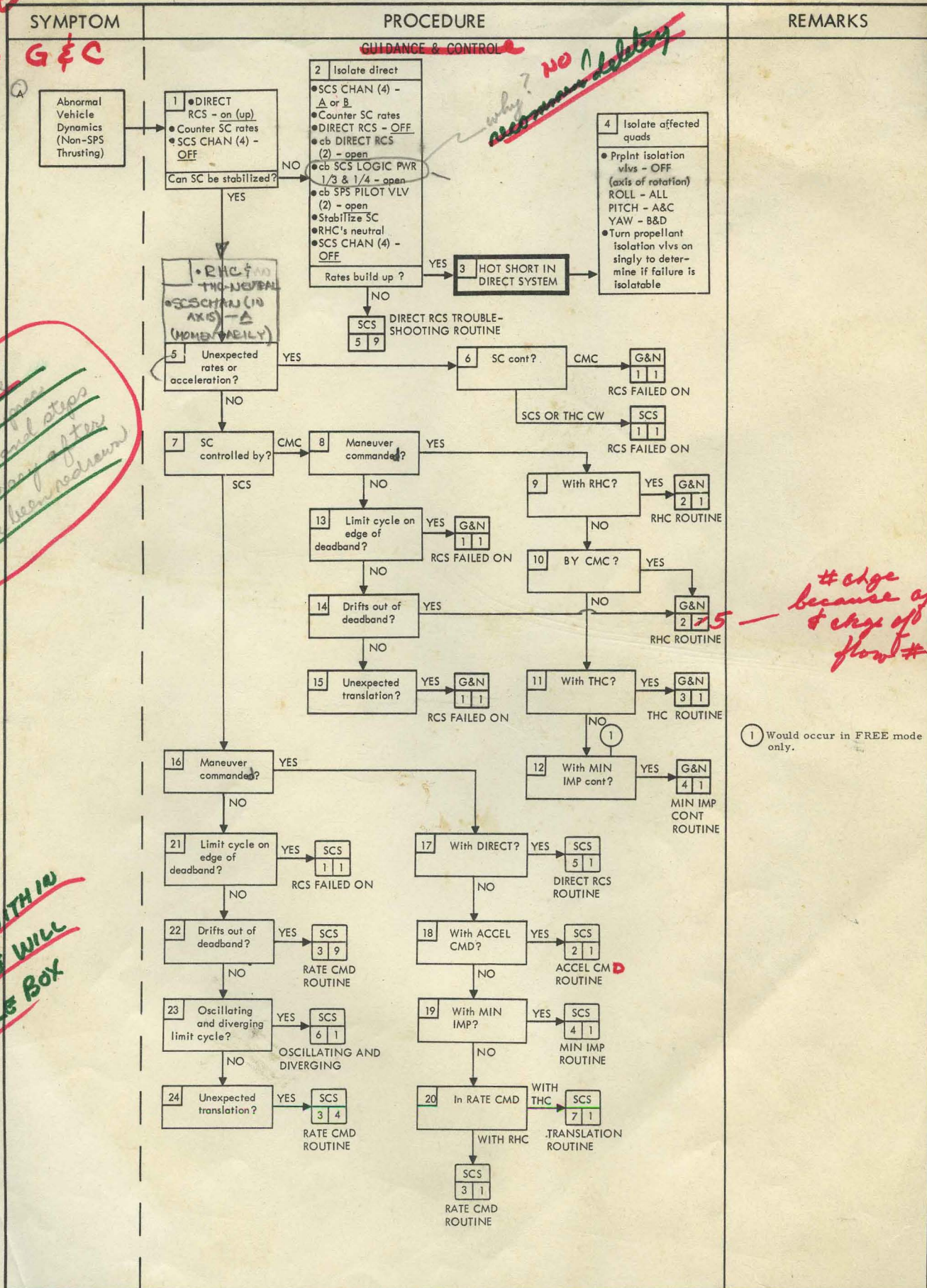
① Would occur in FREE mode only.



**SWIGERT**

SM2A-03-SC 10 1-(2)  
APOLLO OPERATIONS HANDBOOK

G&C  
MALFUNCTION



Basic Date

1 March 1968

Change Date

Page

5-56



G & N READY TO GO!  
4-5



Gary Coen

will draw up proc  
for gets on sep

at SIVB  
relay latches SMC  
action - deactivate MIBus A

? ? ?  
( . . .

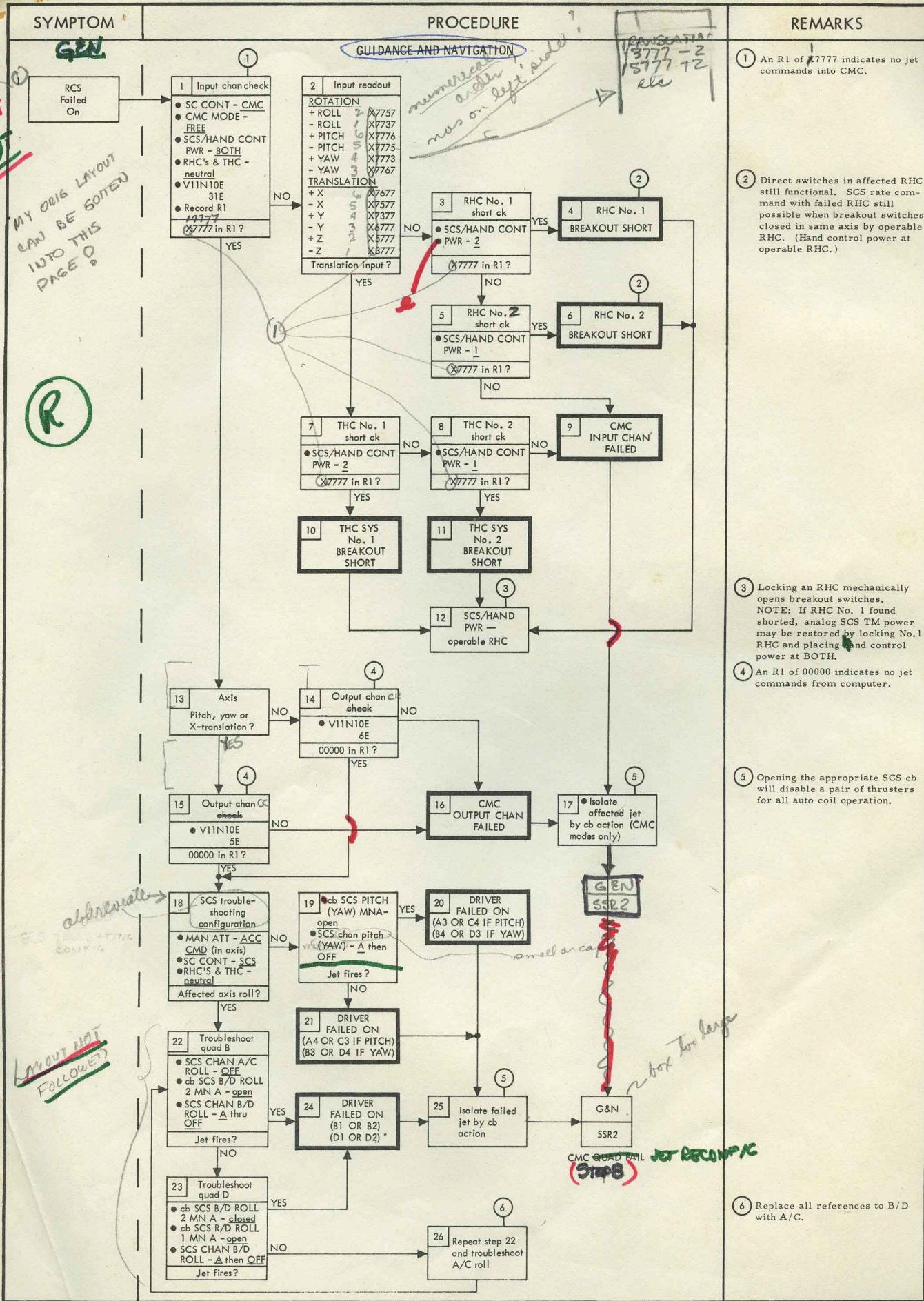


Layout 4-6

SM2A-03-SC 101-(2)  
APOLLO OPERATIONS HANDBOOK

SWIGERT

G&C  
MALFUNCTION



OK except layout 4-5

MY ORIG LAYOUT CAN BE SORTED INTO THIS PAGE

(R)

abbreviate

LAYOUT NOT FOLLOWED

CMC QUAD FAIL JET RECOMPX (STEP 8)

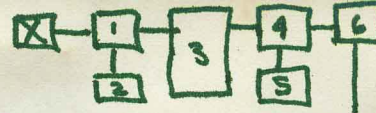
box too large



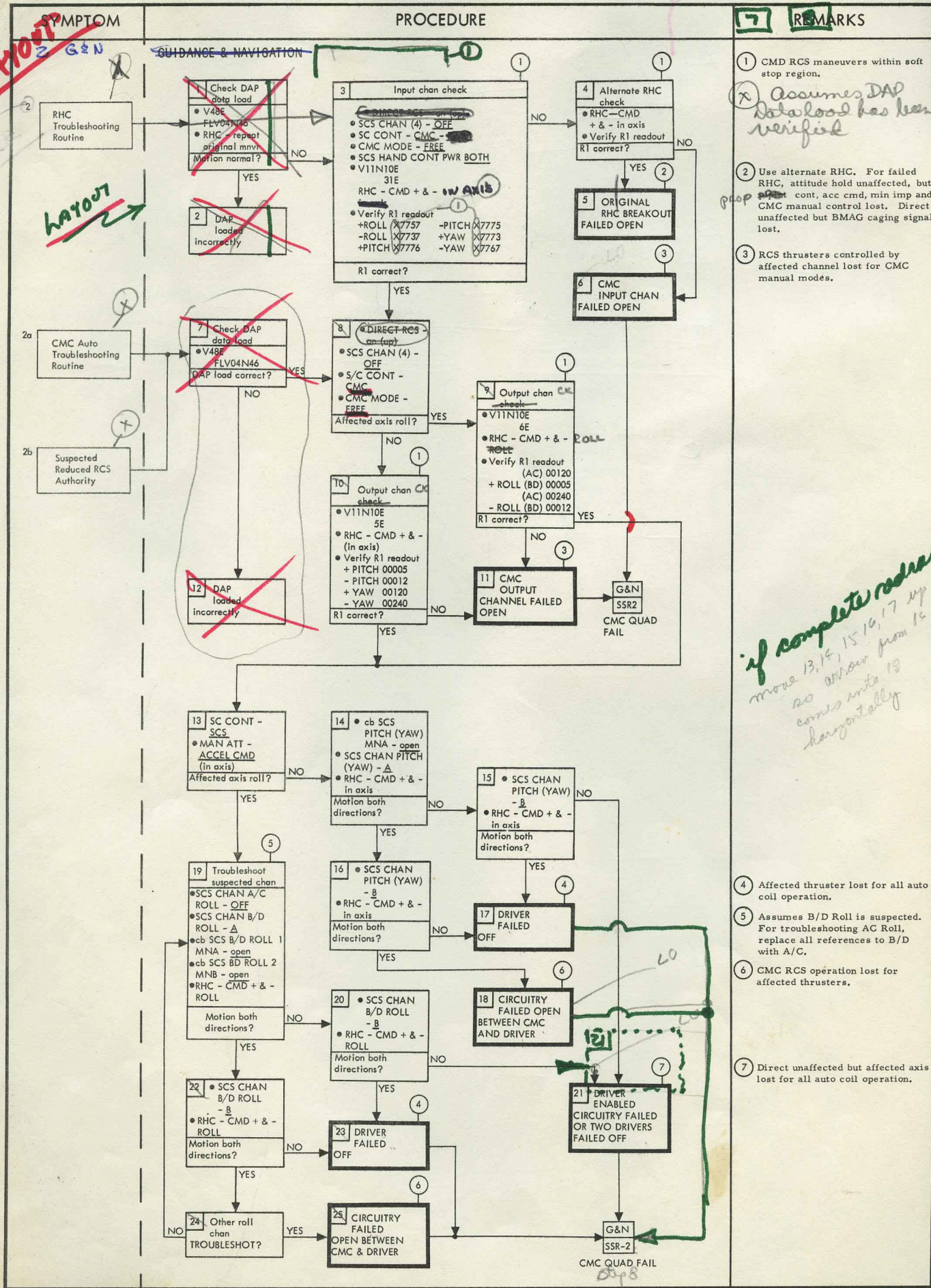


- 4 Affected thruster lost for all auto coil operation.
- 5 Assumes B/D Roll is suspected. For troubleshooting AC Roll, replace all references to B/D with A/C.
- 6 CMC RCS operation lost for affected thrusters.
- 7 Direct unaffected but affected axis lost for all auto coil operation.





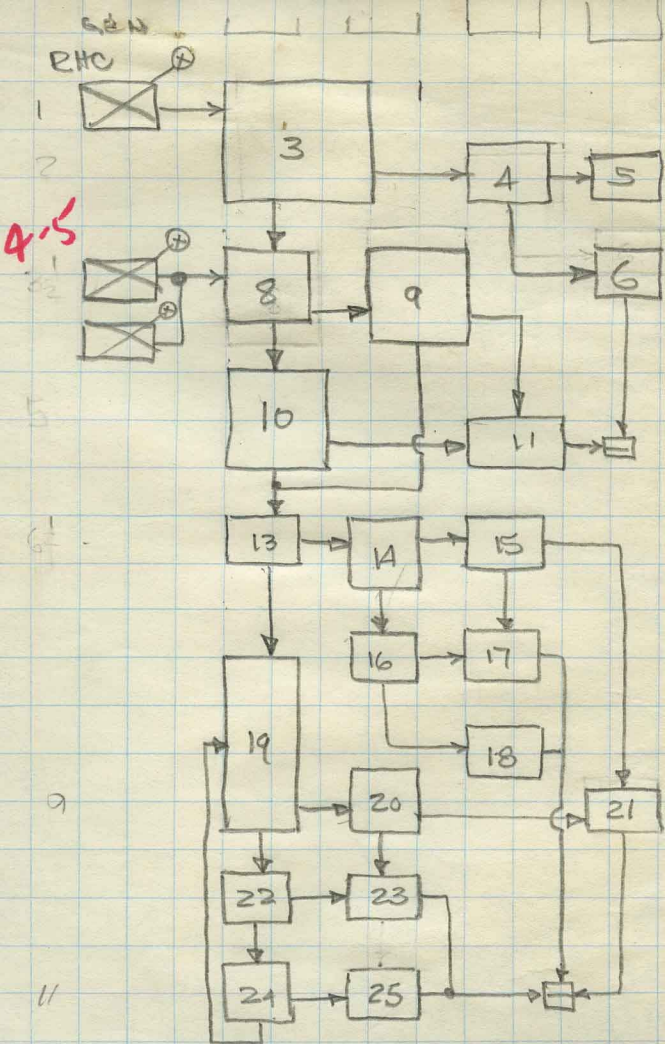
MALFUNCTION



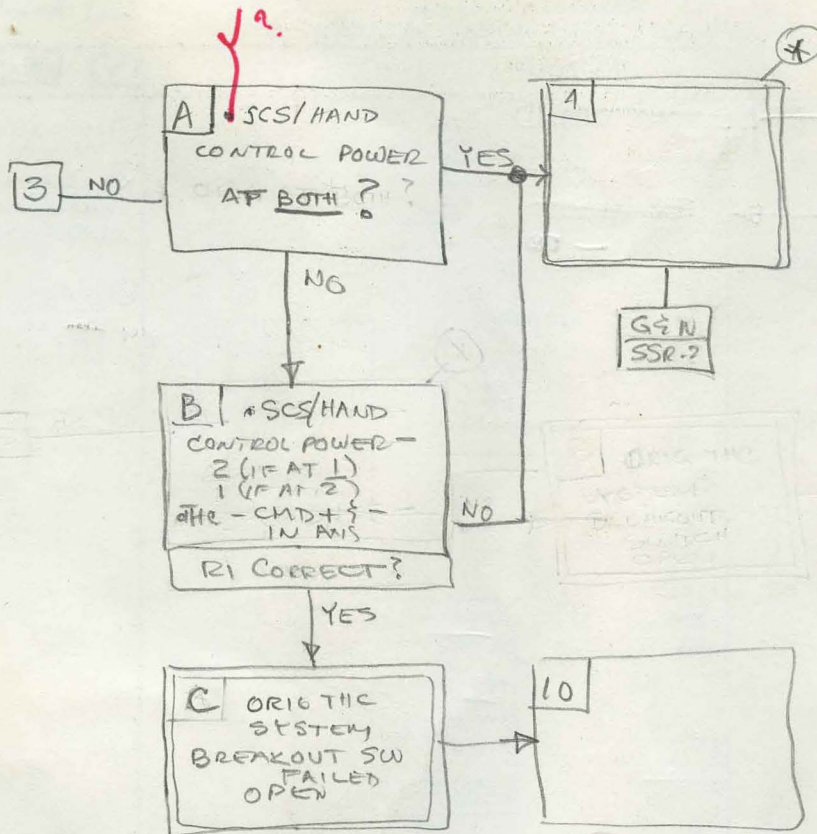
- ① CMD RCS maneuvers within soft stop region.
- ② Use alternate RHC. For failed RHC, attitude hold unaffected, but ~~att~~ cont, acc cmd, min imp and CMC manual control lost. Direct unaffected but BMAG caging signal lost.
- ③ RCS thrusters controlled by affected channel lost for CMC manual modes.
- ④ Affected thruster lost for all auto coil operation.
- ⑤ Assumes B/D Roll is suspected. For troubleshooting AC Roll, replace all references to B/D with A/C.
- ⑥ CMC RCS operation lost for affected thrusters.
- ⑦ Direct unaffected but affected axis lost for all auto coil operation.

*if complete redraw show move 13, 14, 15, 16, 17 up so arrow from 12 comes into 13 horizontally*

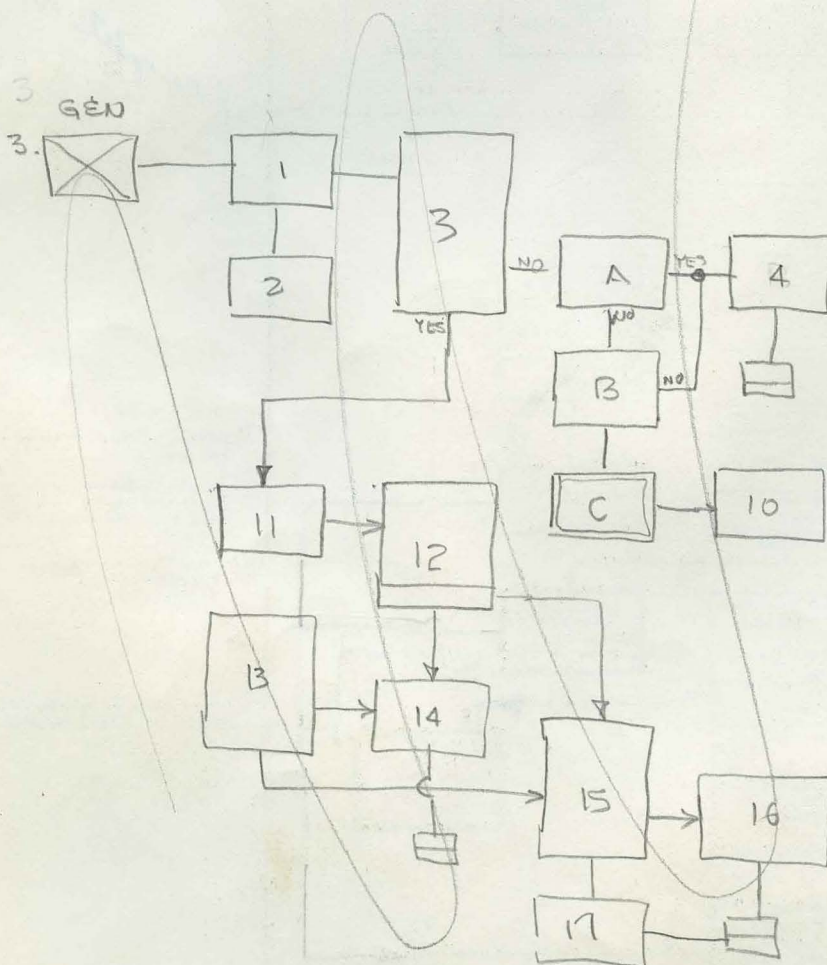




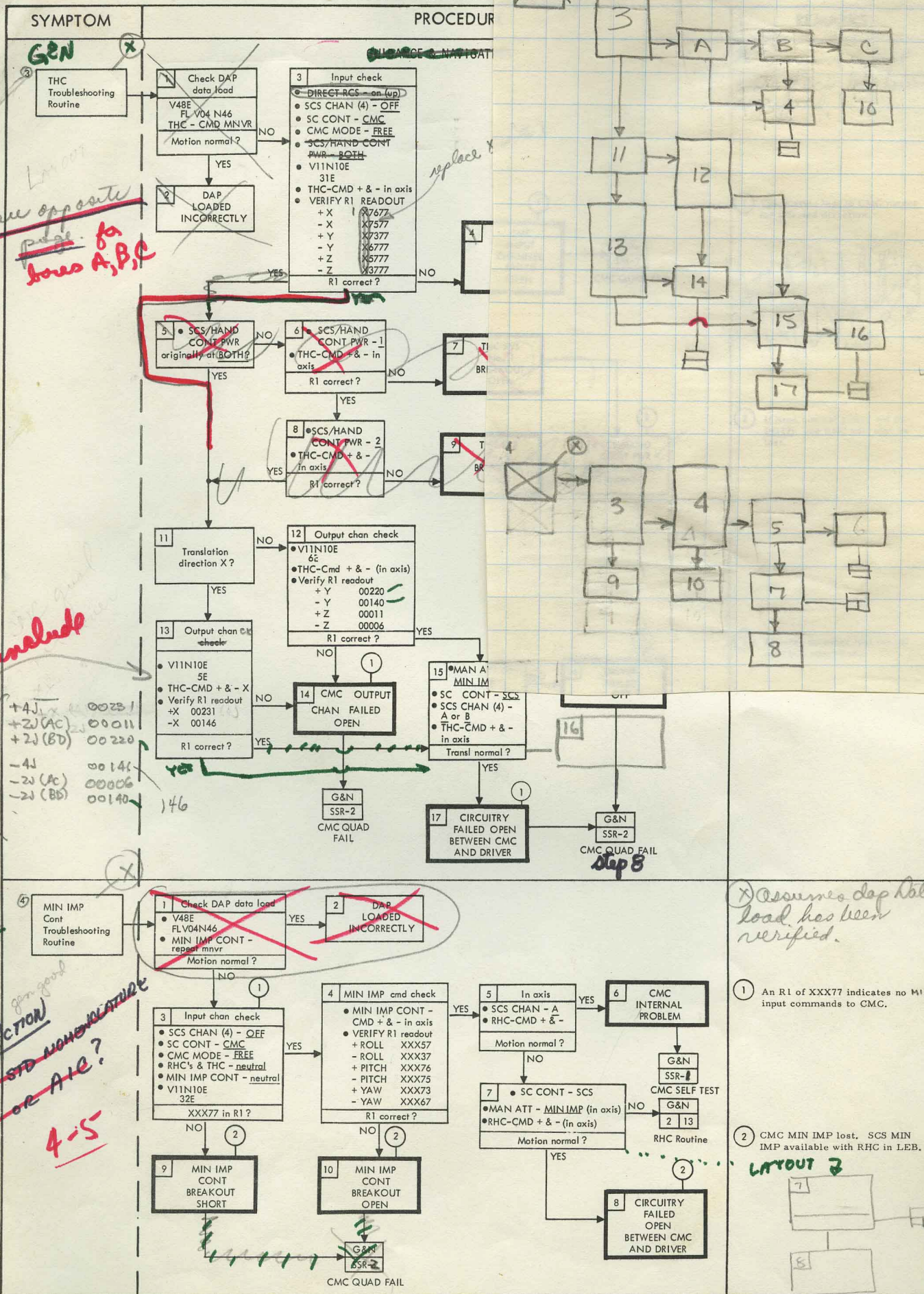




② The remote possibility of both THC system B/O switches failing open can be determined by attempting a translation with the SC control at SCS







OK 4-5  
see opposite page for boxes A, B, C

include

+4J 00231  
+2J (AC) 00011  
+2J (BD) 00220  
-4J 00146  
-2J (AC) 00006  
-2J (BD) 00140

LAYOUT  
NASA ACTION  
WHAT IS STD NON-REPLACEMENT  
MIC OR ALE?  
4-5

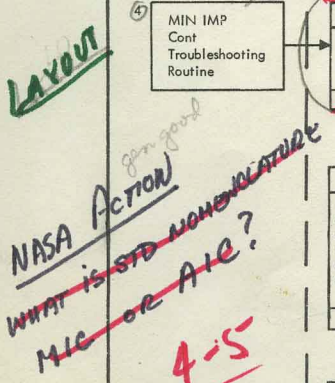
Assumes dep table load has been verified.

1 An R1 of XXX77 indicates no MIN IMP input commands to CMC.

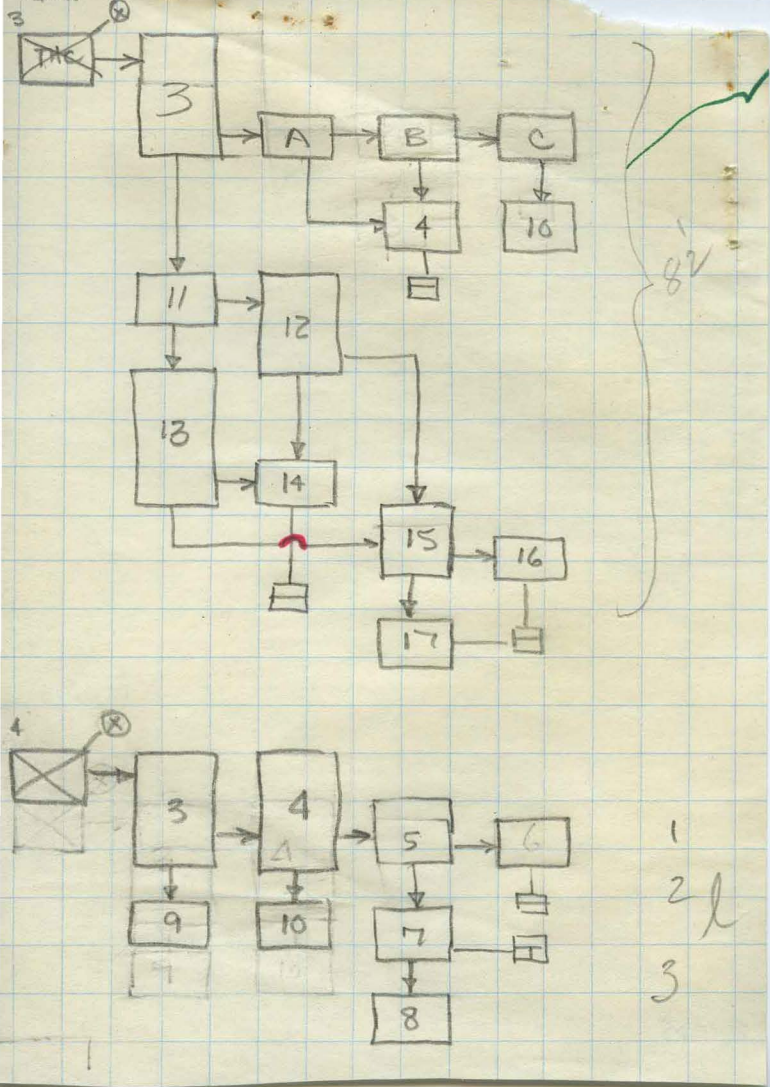
2 CMC MIN IMP lost. SCS MIN IMP available with RHC in LEB.

LAYOUT 3





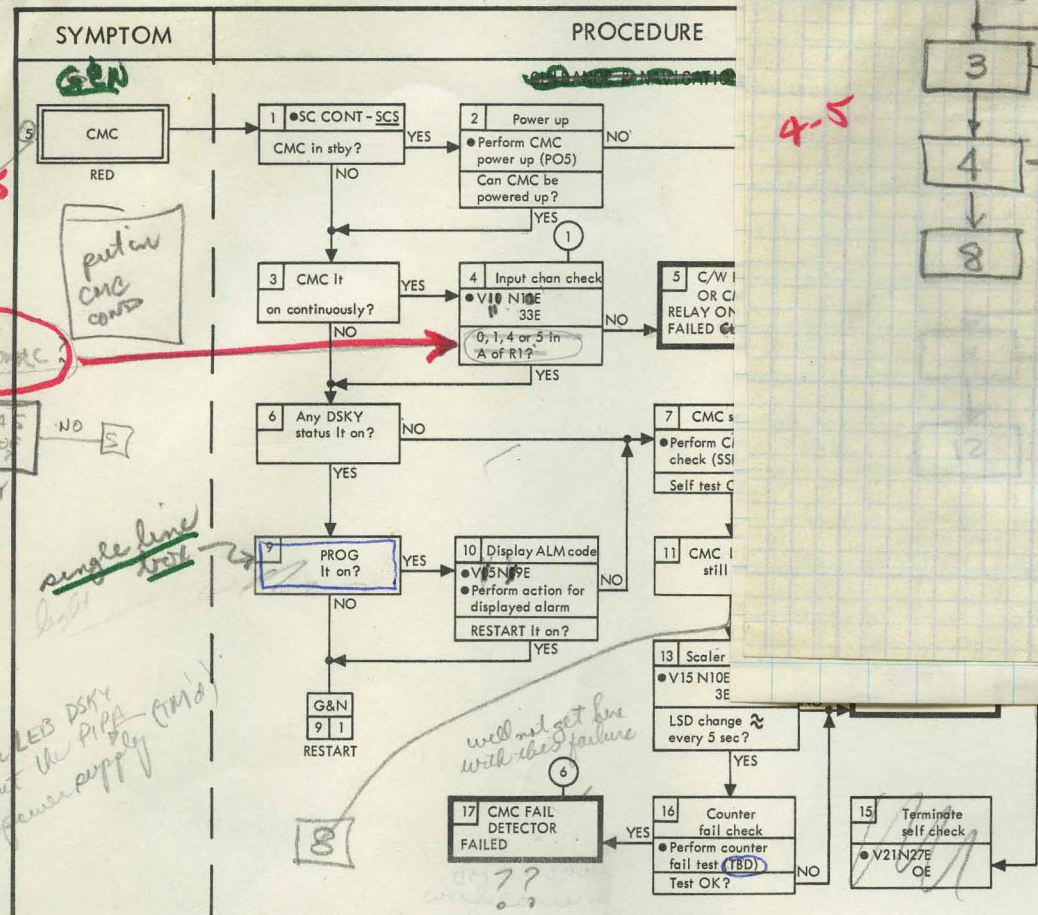
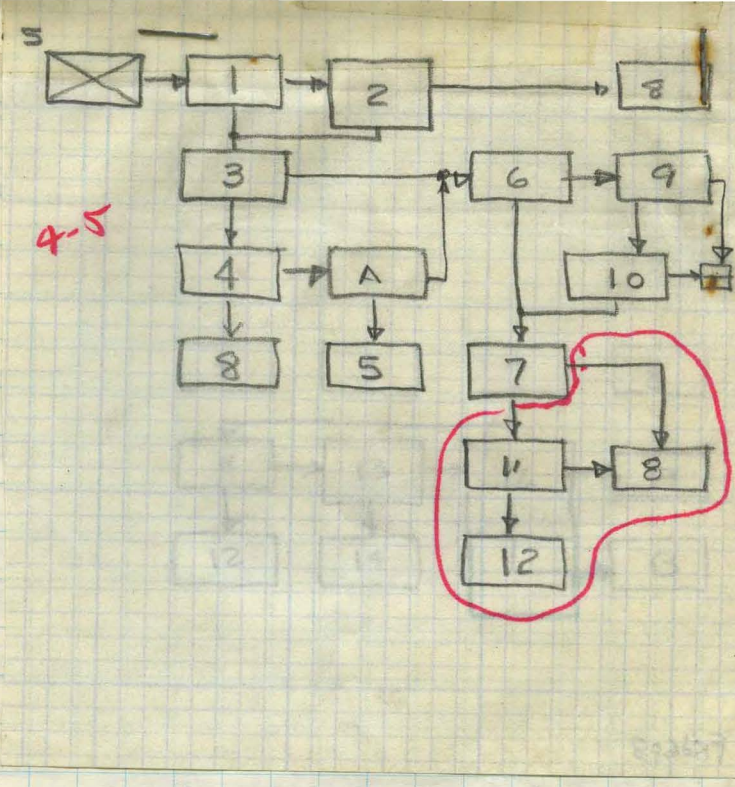






Layout 4-7 & 4-8 B2

SM2A-03-SC101-2  
APOLLO OPERATIONS HANDBOOK



of both TVC and entry cond

6 Complete identification of subsequent failures impossible. Partial identification from DSKY status lights.

1 Subsequent ISS malfunction indications from unaffected ISS light.

2 ISS malfunction indication lost from this warning light.

3 PIPA failure during AV G will cause an ISS light which will be extinguished at the termination of AV G.

4 CMC monitor and control of both TVC and entry lost.

5 Affects issuance of an ISS light command.

6 Subsequent indications of an ISS failure lost.

7 IMU may be used as a total attitude reference only. CMC/IMU ATTITUDE INTERFACE LOST.

put this sent first

SM-2A-1604

Basic Date

Change Date

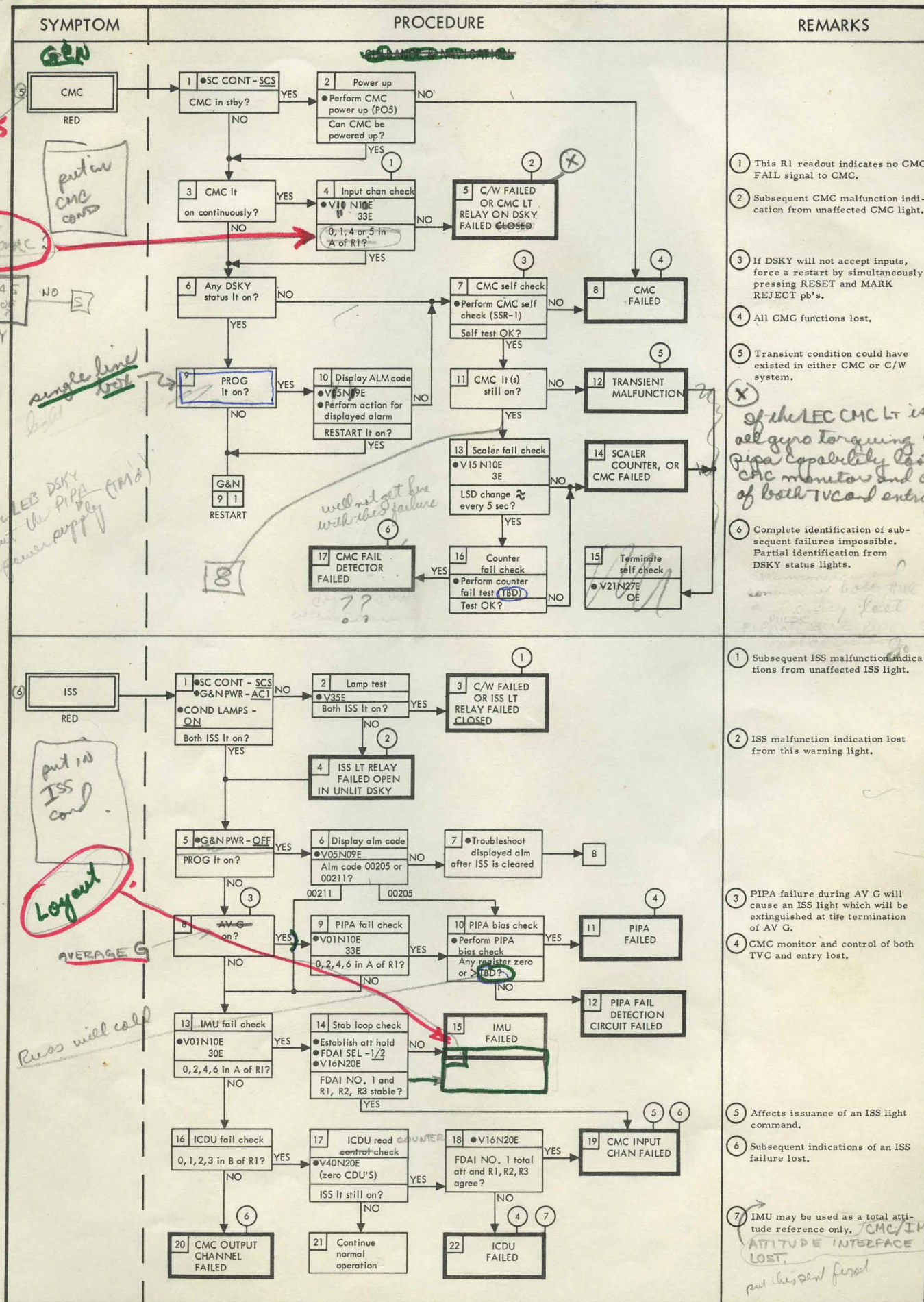
Page



Layout 4-7 & 4-8 B2

# SM2A-03-SC101-(2) APOLLO OPERATIONS HANDBOOK

G&C  
MALFUNCTION



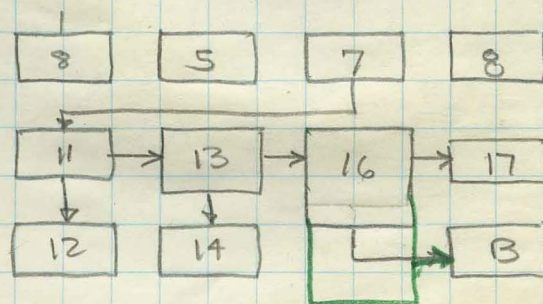
SM-2A-1604

Basic Date

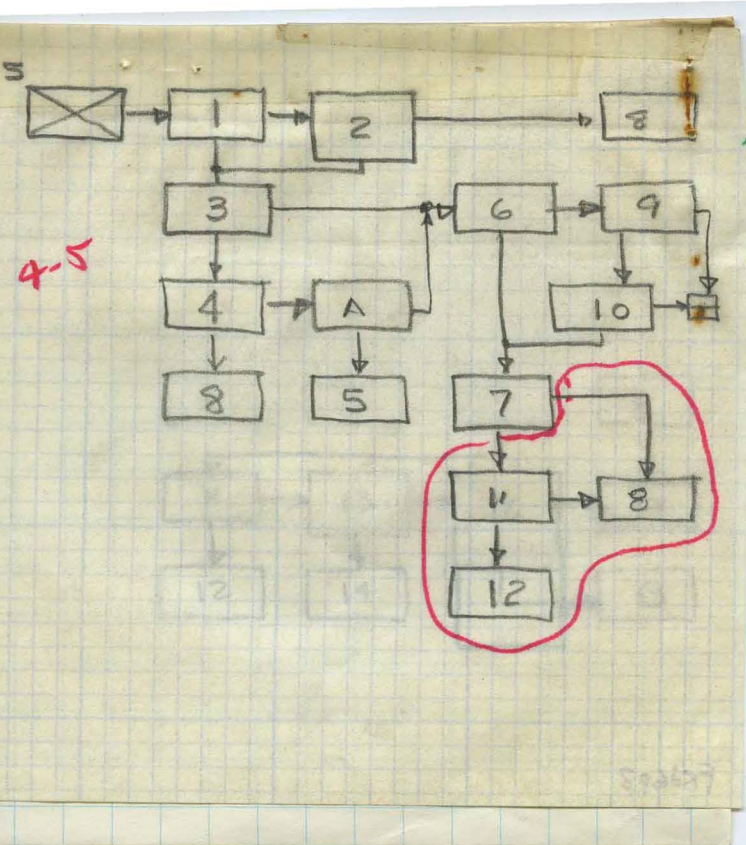
Change Date

Page



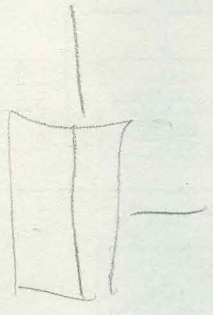








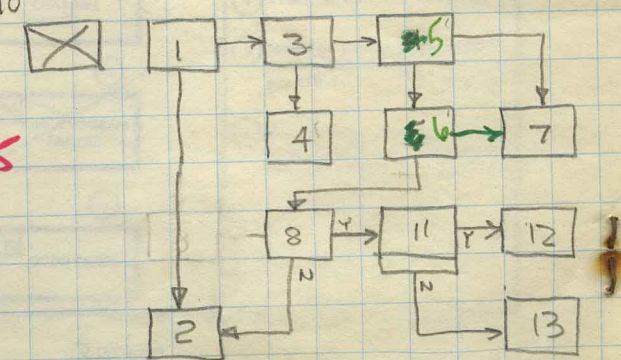
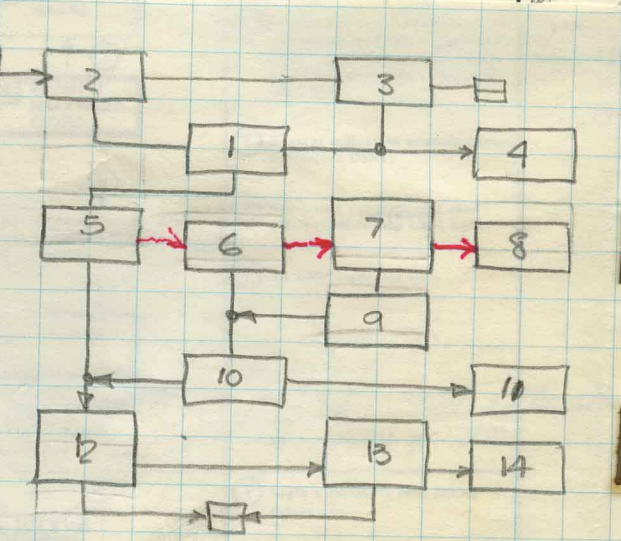
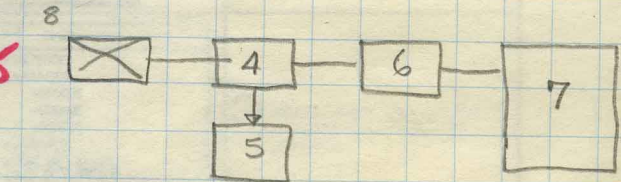
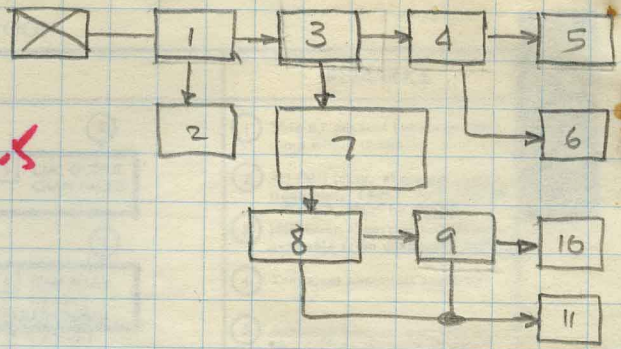
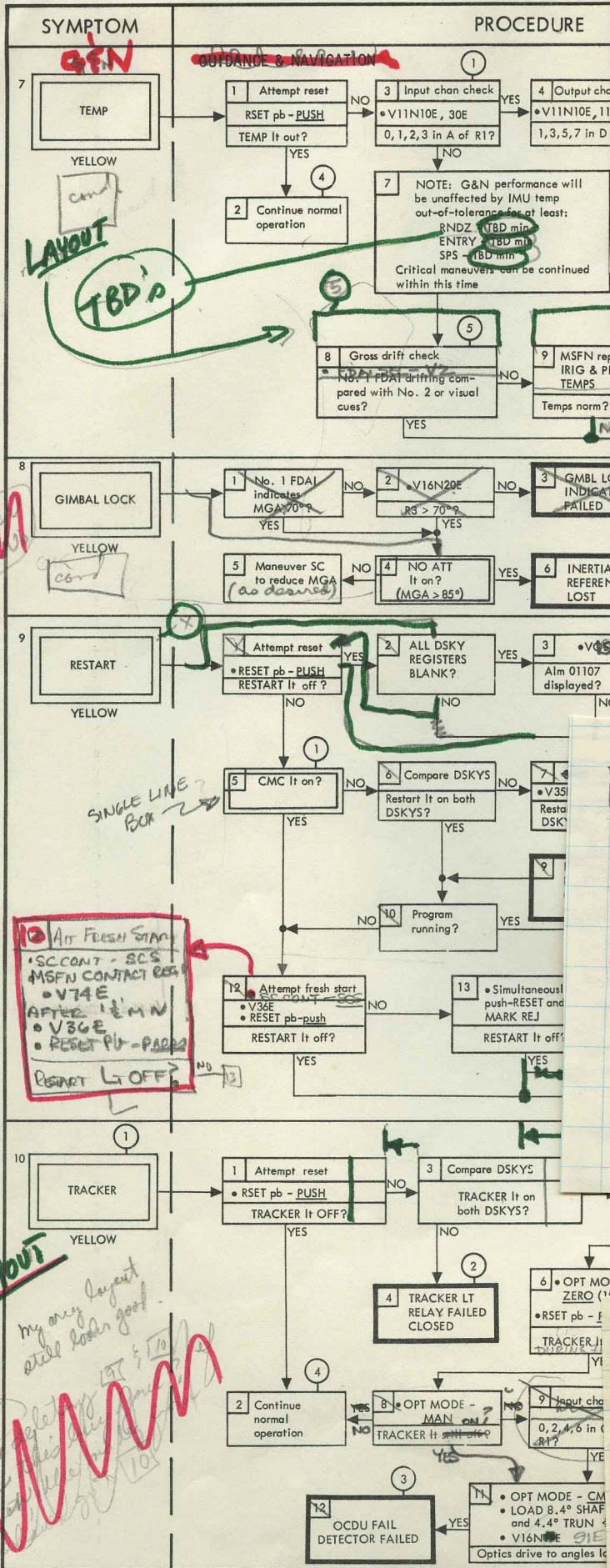
1906





Layout 4-8 BE

SM2A-03-SC 101  
APOLLO OPERATIONS



of PROG ll on, display  
the alarm code and  
perform the reset  
where proceed

put in  
terminal  
the crew  
understand

LAYOUT

my only layout  
still looks good.

MAP ATT

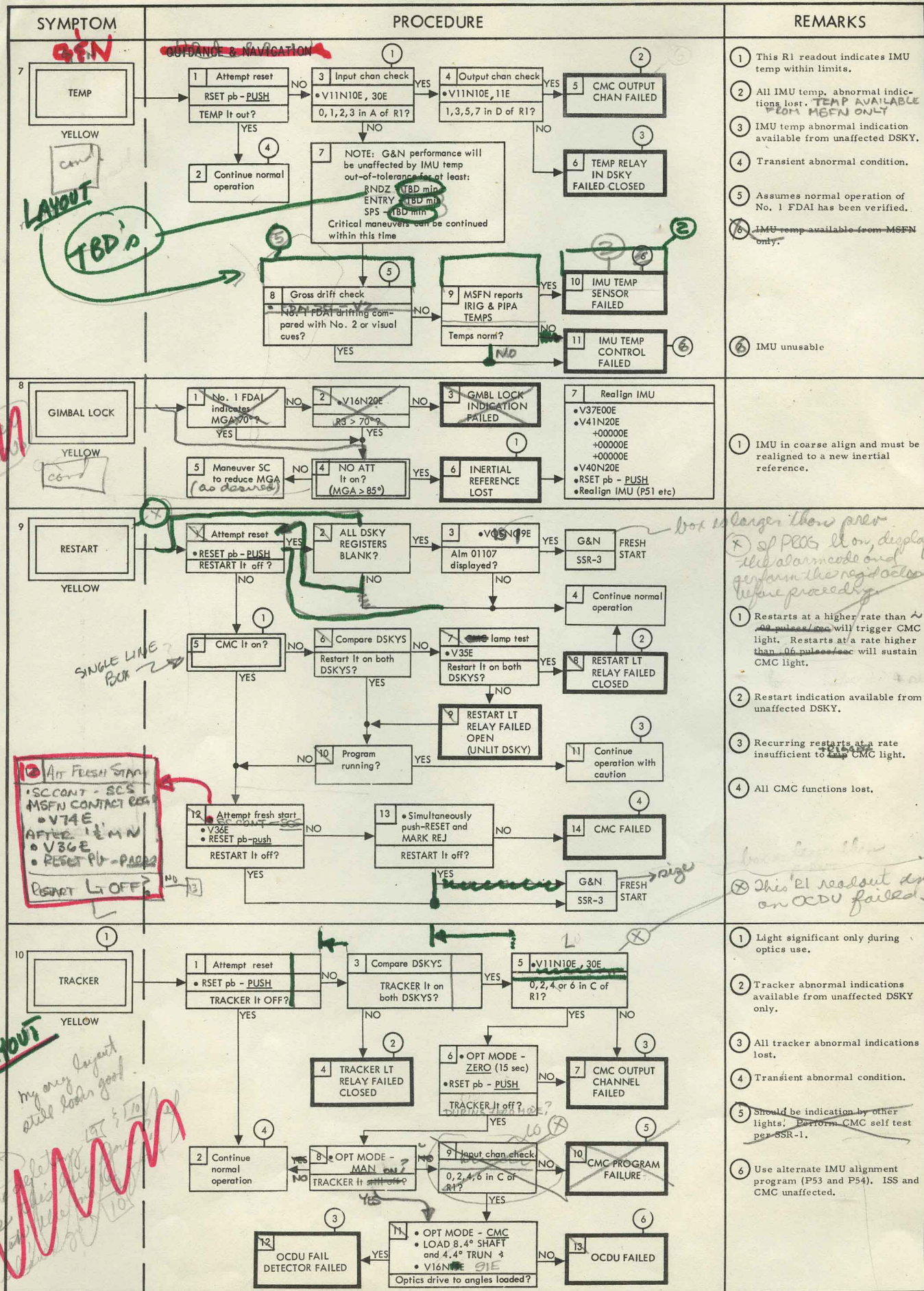
What does  
it mean  
if the  
light is  
on?



Layout 4-8 BE

SM2A-03-SC 101-(2)  
APOLLO OPERATIONS HANDBOOK

G&C  
MALFUNCTION



SM-2A-1605

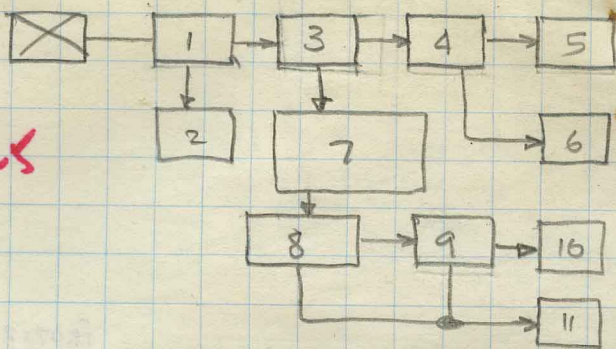
Basic Date

Change Date

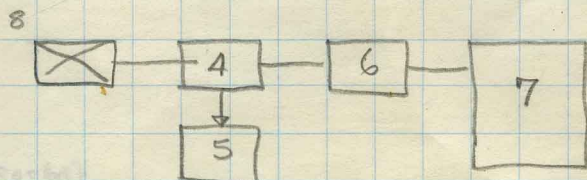
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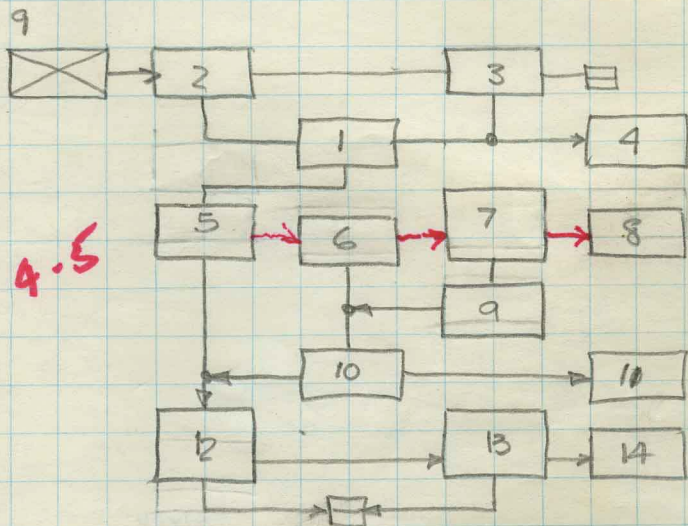
9.5



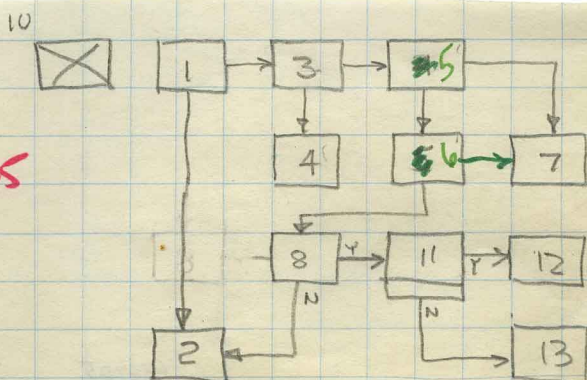
4.5



4.5



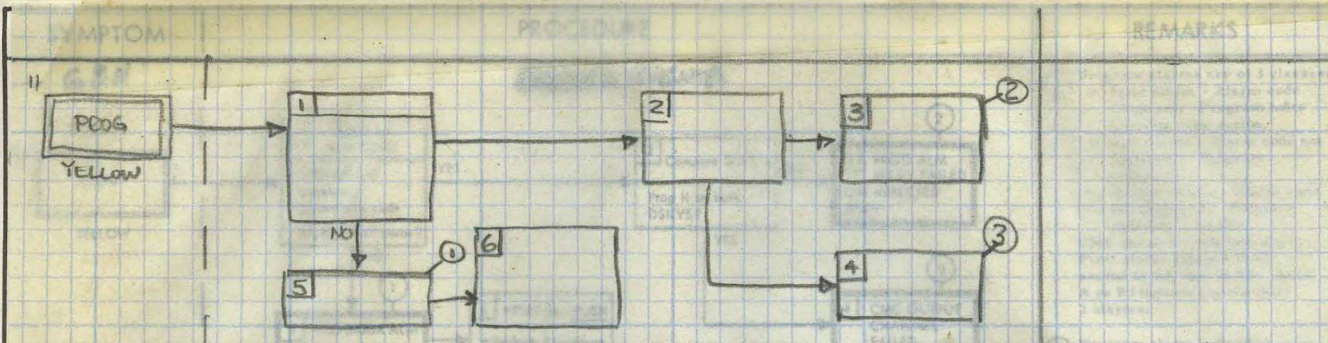
9.5





4-5

TITLES  
ON  
ALL  
ALARM  
CODES



2 ALARM CODES

- 01103
- 01104
- 01110
- 01201
- 01202
- 01203
- 01206
- 01207
- 01210
- 01211
- 01301
- 01302
- 01301
- 01302

NUMBER  
NOTES SEQUENTIALLY  
THRU ALARM CODE  
SECTION

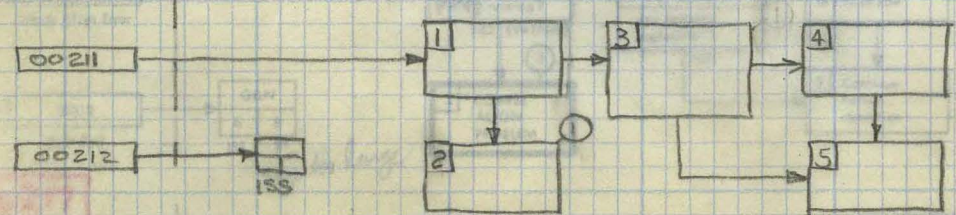
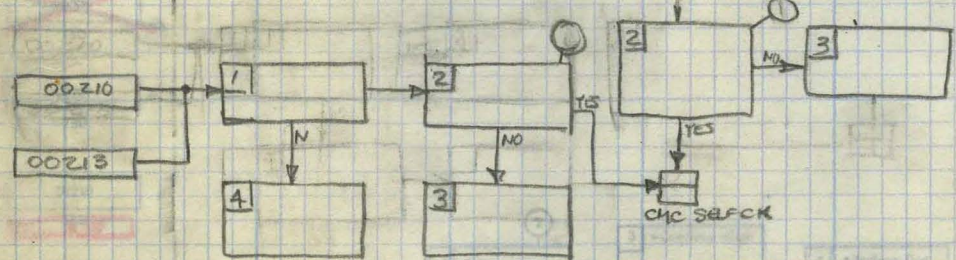
GEN  
SSL1

CNC SELF TEST

GEN  
SSL1  
CNC SELF TEST

ALARM 207  
CAN BE MOVED  
UP  
(IN TOTAL) IF NEEDED

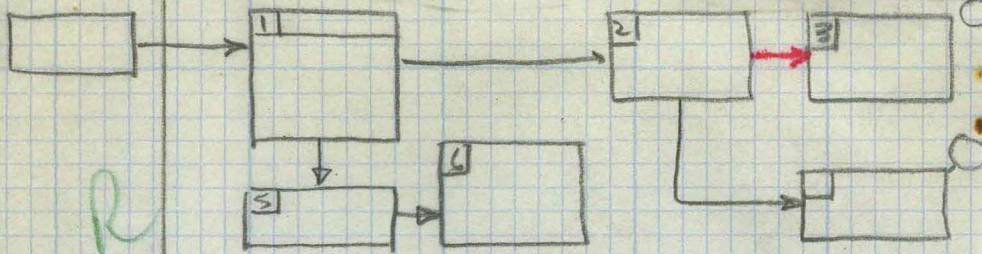
to  
pulse  
unit  
in





60217





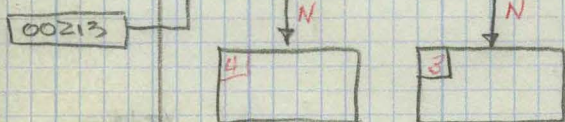
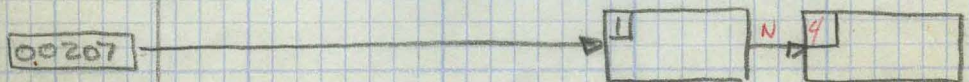
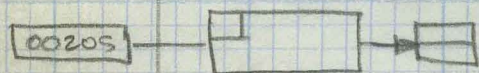
## 2. ALARM CODES

01103
01104
01110
01207
01202
01203
01206
01207
01210
01211
01301
01302
01501
<b>TITLE</b>
01502

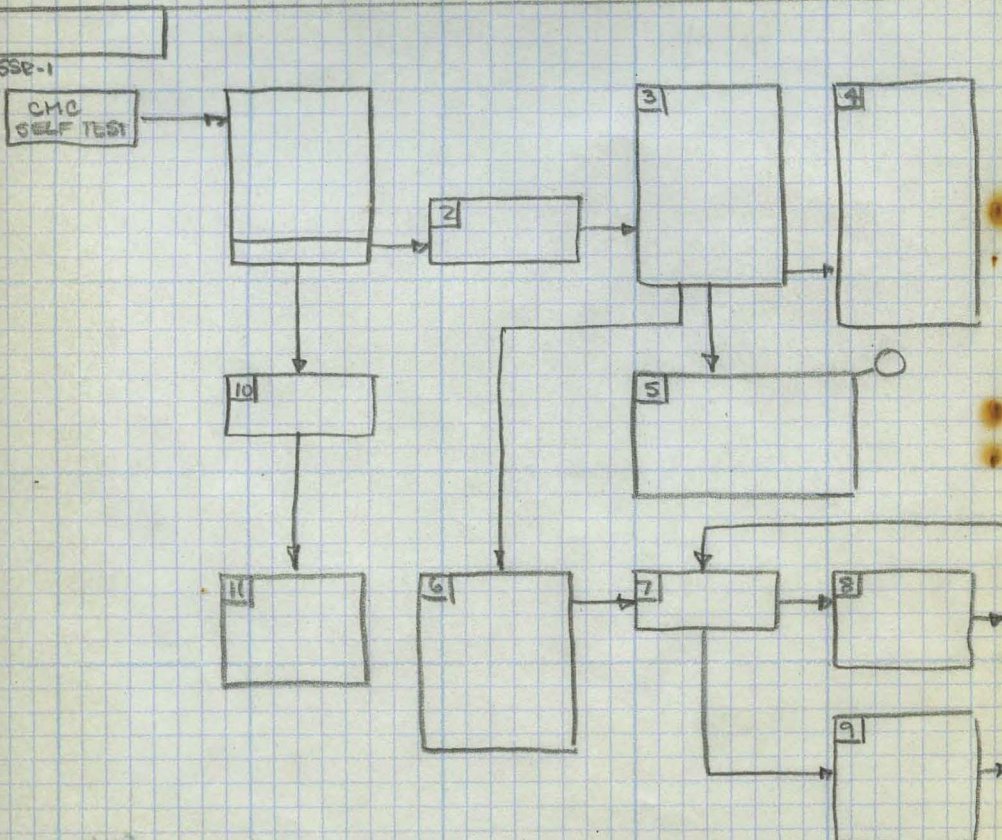
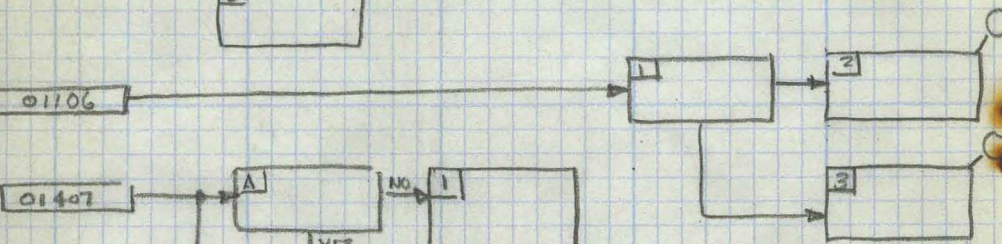
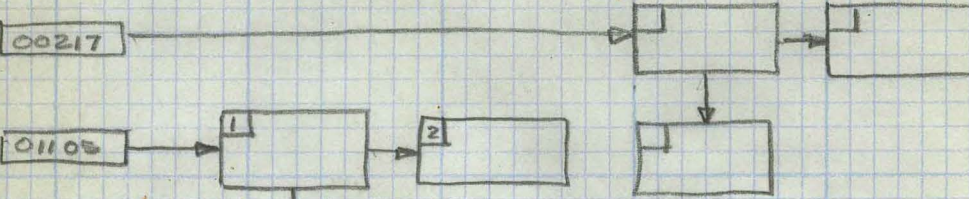
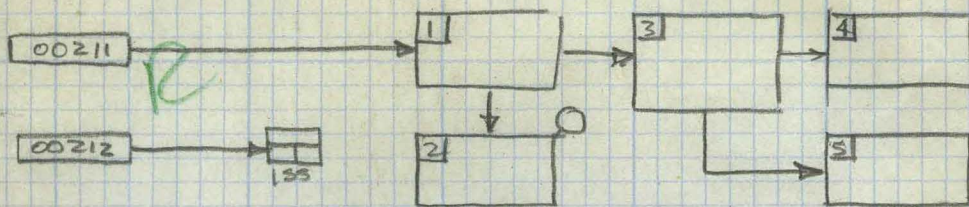
*this layout*

**BONNIE  
ATTACHED ARE TWO  
DIFFERENT LAYOUTS  
FOR THE ALARM CODES  
I DON'T CARE  
WHICH THEY USE**

**THIS ONE PROBABLY  
OFFERS MORE  
ROOM FOR  
TITLES!**







890623



SYMPTOM	PROCEDURE	REMARKS
ALARM CODES (CONT)		
00217		
01105 Downlink Too Fast		<p>④ Downlink data transmitted at time of alarm may not be correct. Update must be manually verified or loaded.</p>
01106 Uplink Too Fast		<p>⑤ Perform subsequent CMC ground updates by voice link.</p>
01407 01410		<p>⑥ Uplink data being sent when alarm occurred should be retransmitted.</p>
SPECIAL SUB-ROUTINES SSR-1		<p>① If CMC light is ON, proceeding beyond this point is a crew option.</p> <p>② Problem is in erasable memory.</p> <p>③ Subsequent use of the CMC is dependent upon MSFN evaluation (via down link) of the preceding steps in self test.</p> <p>④ Problem is CMC control problem (00001) or special register or central problem (00002).</p> <p>⑤ Problem is in fixed memory.</p> <p>⑥ R2 = 00001 for 35-45 MSEC R2 = 00002 for ~20 SEC R2 = 00003 for ~7 SEC R2 = 00004 for ~43 SEC</p>

SM-2A-1607



PITCH

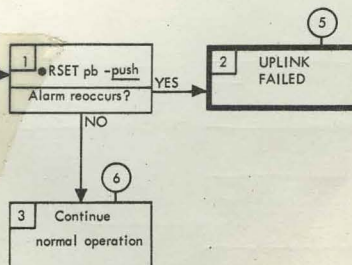
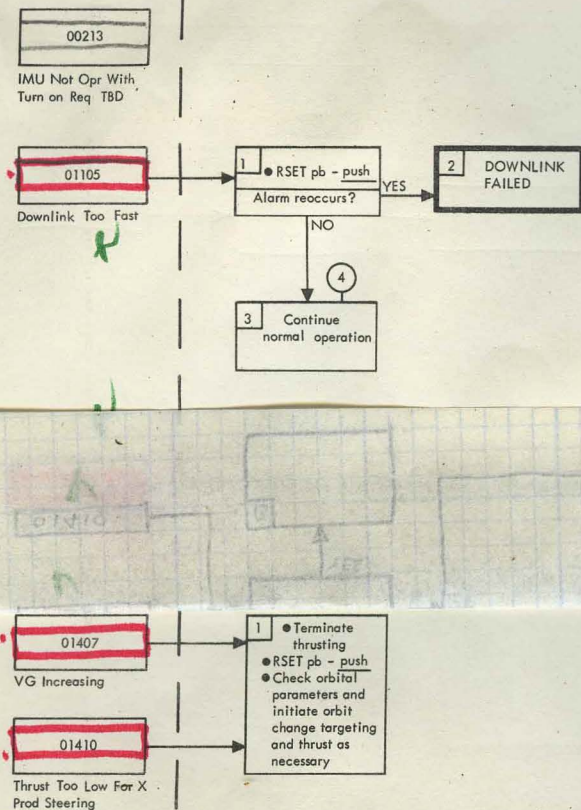
13	A-C ISOLATION
• FB SCS PITCH MNAH • OPEN (FAILED) ON • JE ONLY) EN	
• SCS CHAN — A (IF A3 00C4) B (IF C4 00A3)	
• 01XYE • 01111E • PRO	



REMARKS

ALARM CODES (CONT)

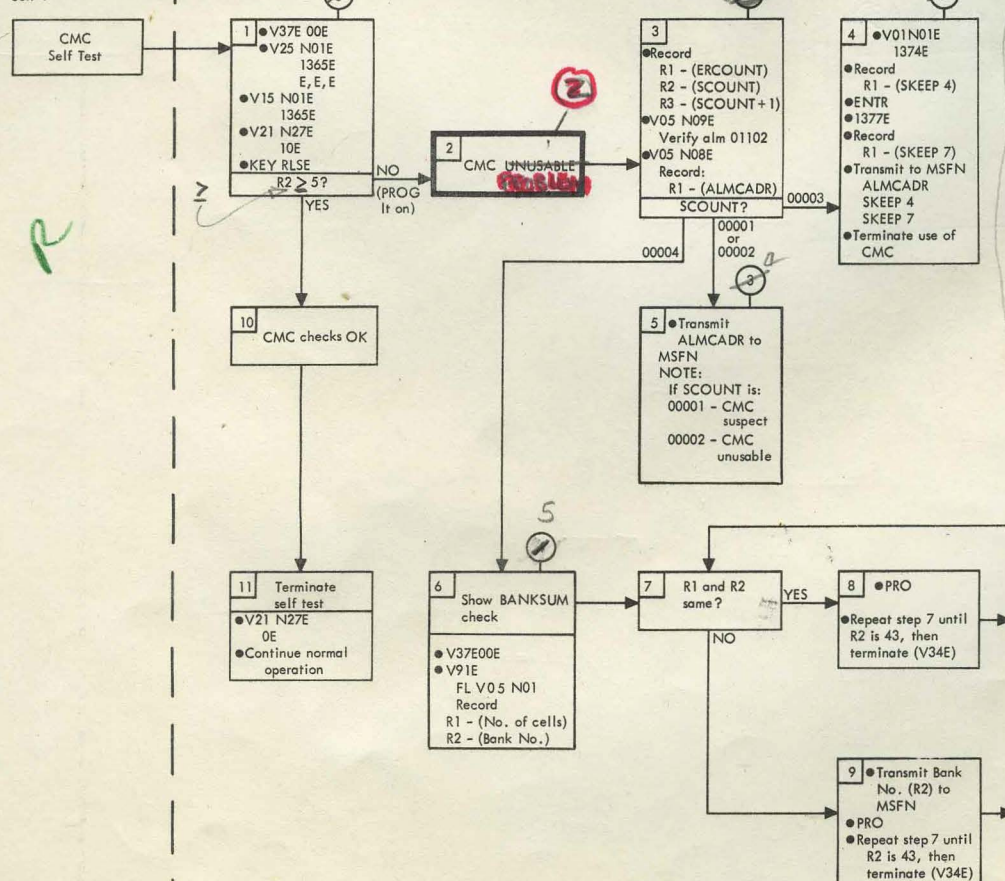
**GUIDANCE & NAVIGATION**



- ④ Downlink data transmitted at time of alarm may not be correct. Update must be manually verified or loaded.
- ⑤ Perform subsequent CMC ground updates by voice link.
- ⑥ Uplink data being sent when alarm occurred should be retransmitted.

SPECIAL  
SUB-ROUTINES

SSR-1



- ① If CMC light is ON, proceeding beyond this point is a crew option.
- ② Problem is in erasable memory.
- ③ Subsequent use of the CMC is dependent upon MSFN evaluation of the succeeding steps in self test.
- ④ Problem is CMC control problem (00001) or special register or central problem (00002).
- ⑤ Problem is in fixed memory.
- ⑥ R2 = 00001 for 35-45 MSEC  
R2 = 00002 for ~20 SEC  
R2 = 00003 for ~7 SEC  
R2 = 00004 for ~43 SEC



Layout 4-6

SM2A-03-SC 101-(2)  
APOLLO OPERATIONS HANDBOOK

ROTATION  
TRANSLATION

G&C  
MALFUNCTION

SPECIAL  
SUB-ROUTINES

PROCEDURE

REMARKS

GUIDANCE & NAVIGATION

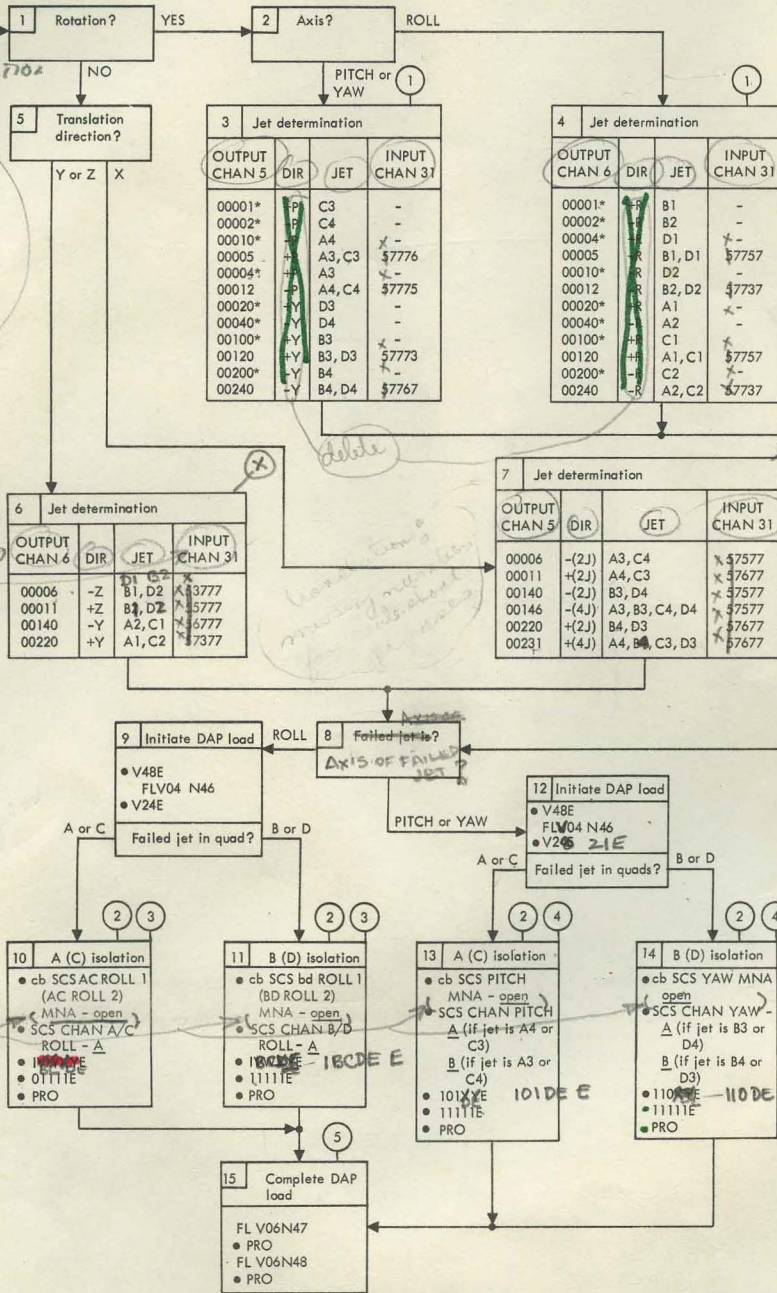
BEN SSR-2

CMC Quad-Fail

CMC JET RECONFIGURATION

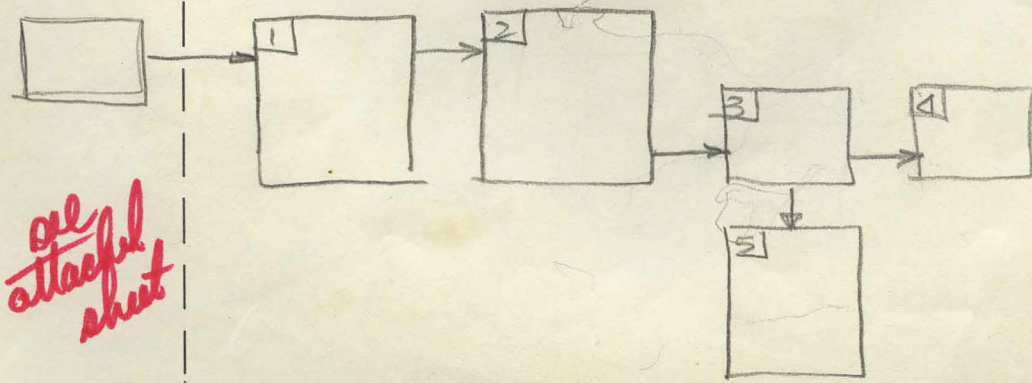
LAYOUT  
THIS IS  
TERRIBLE

BONNIE  
CAN'T WE TRY MY  
ORIGINAL  
LAYOUT

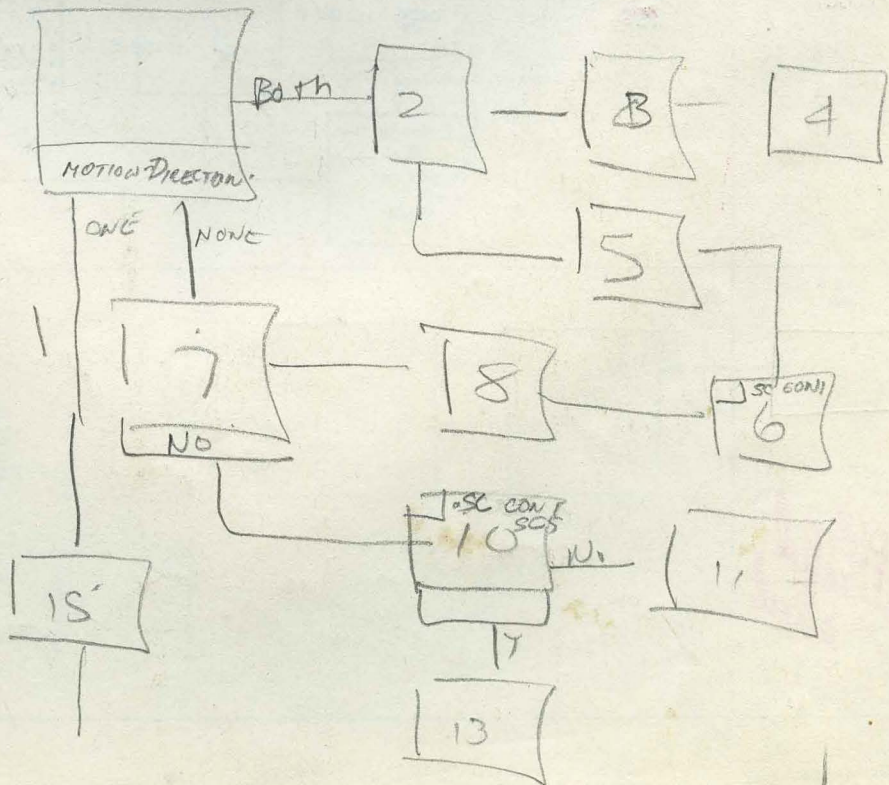
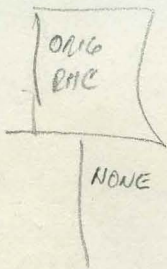
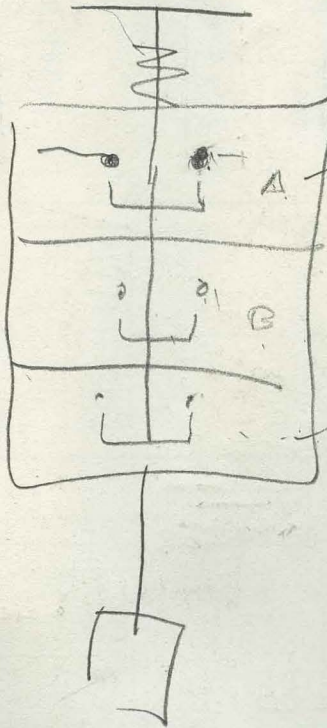
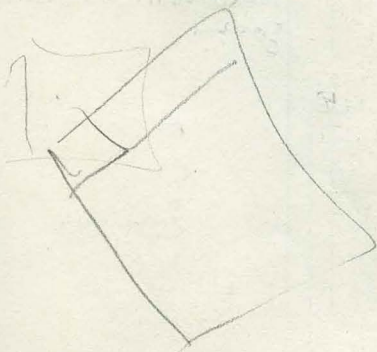


- Starred (\*) outputs are single jet commands. For the failed jet, isolate indicated jet. For RCS failure on the failed jet as the indicated jet. For output channel failed open, the failed jet is the corresponding jet in the rotational control.
- In R1,  $\Delta$  is DAP deadband  
 0 - 0.5°  
 1 - 5.0°  
 $\Delta$  is the DAP rate  
 0 - 0.05°/sec  
 1 - 0.20°/sec  
 2 - 0.5°/sec  
 3 - 4.0°/sec  
 In R1,  $\Delta$  is quads A/C for X translation:  
 0 - FAIL A/C  
 1 - USE A/C  
 In R1,  $\Delta$  is quad B/D for X translation:  
 0 - FAIL B/D  
 1 - USE B/D  
 In R2, A is ROLL SELECTION  
 0 - USE B/D  
 1 - USE AC
- Translation (Y or Z) will be single jet and result in excessive RCS prprint consumption.
- Rotations (pitch or yaw) will be single jet. X translations will be 2 jet.
- N47 and N48 display other DAP parameters assumed to be correct.

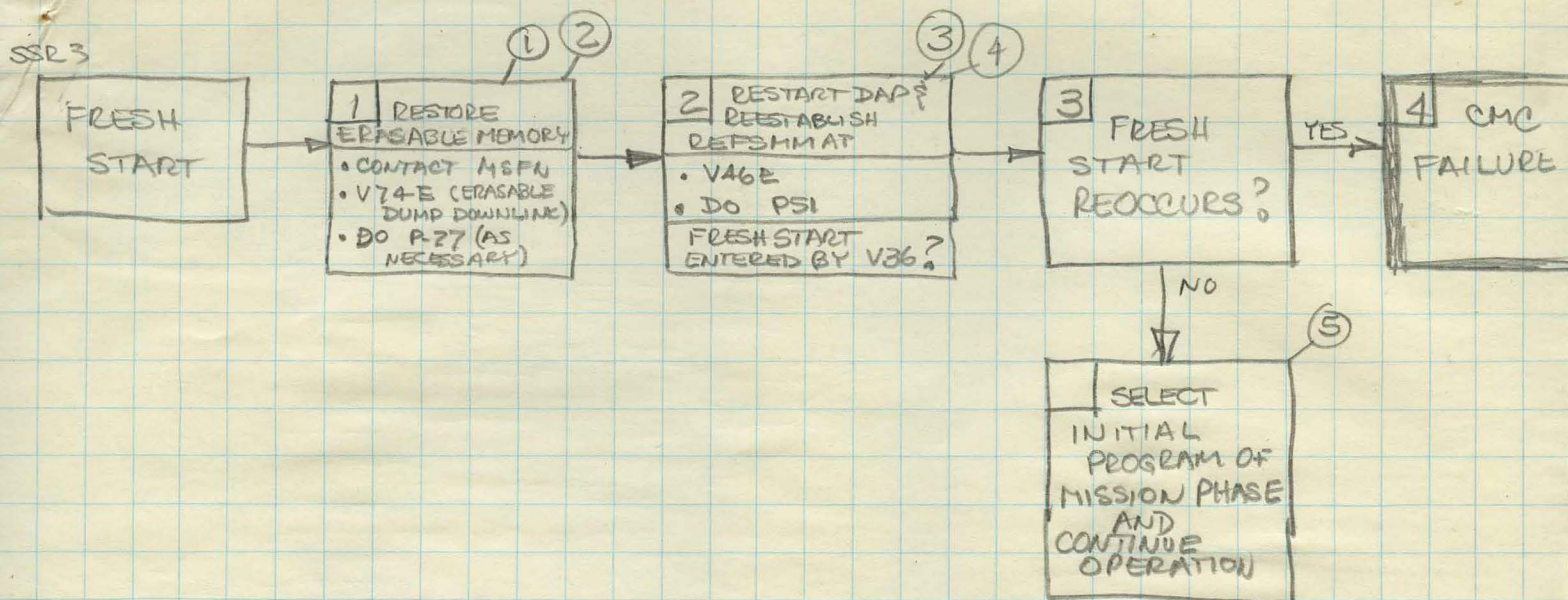
SSR-3











- ① The State vector and CMC time should be updated. All non pad-loaded parameters, except time and state vector will be properly updated by performance of the CMC programs in their proper sequence just as if the CMC had been turned on when the FRESH START occurred.
- ② Extended Verb 74 permits MSFN to examine all pertinent erasable locations to determine if any parameters need reloading.
- ③ The DAP is shut off by a Fresh Start and must be reinitiated by V46.
- ④ The Refreshmat Flag is reset by a Fresh Start and the stored refreshmat may be invalid, so P51 and P52 must be performed.
- ⑤ All flagwords are reset by a Fresh Start. The proper flags are set again by the performance of the CMC programs in normal sequence.



6-23

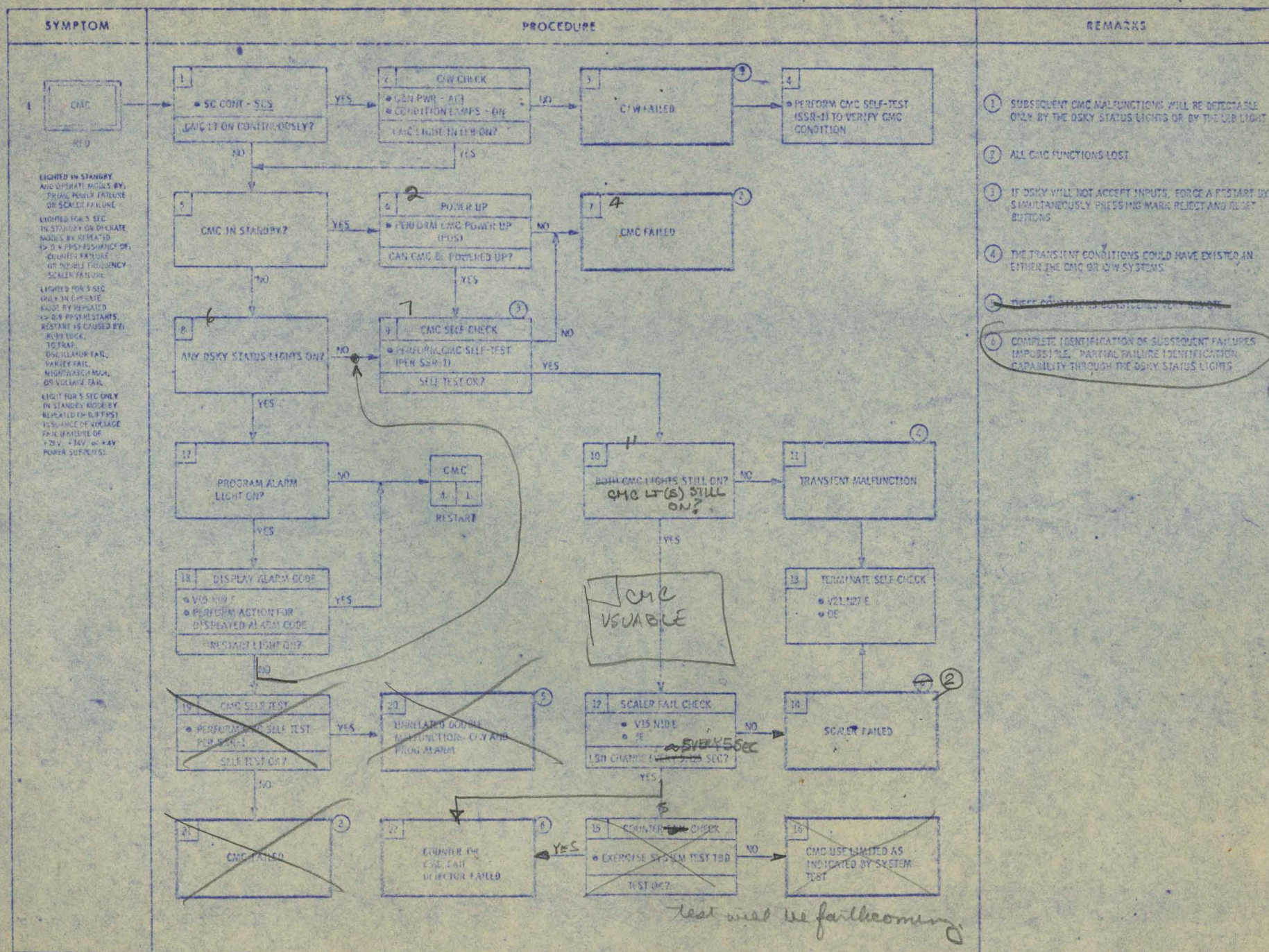


Table 3-4. Malfunction Procedures

(Sheet 1 of 12)



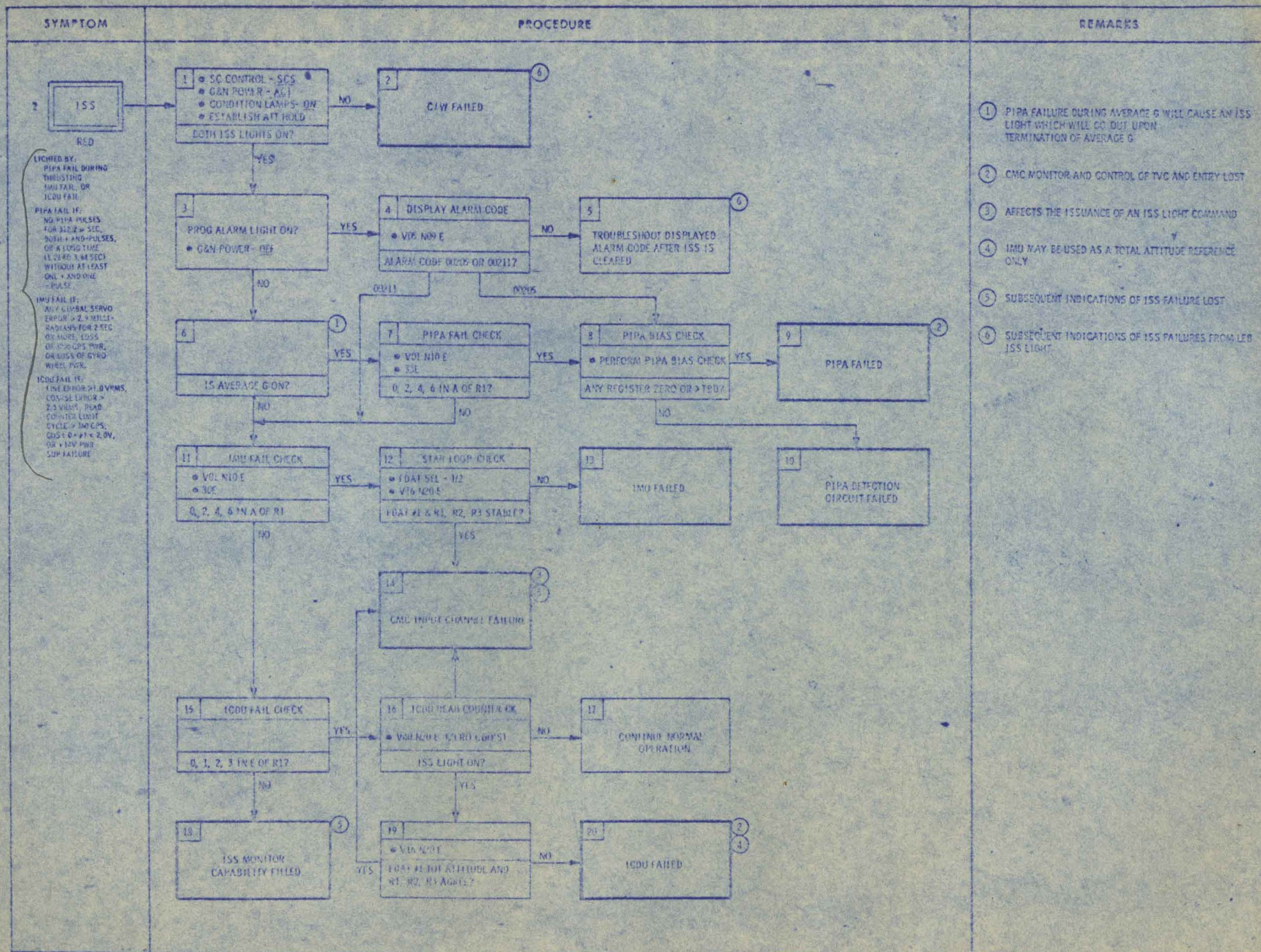
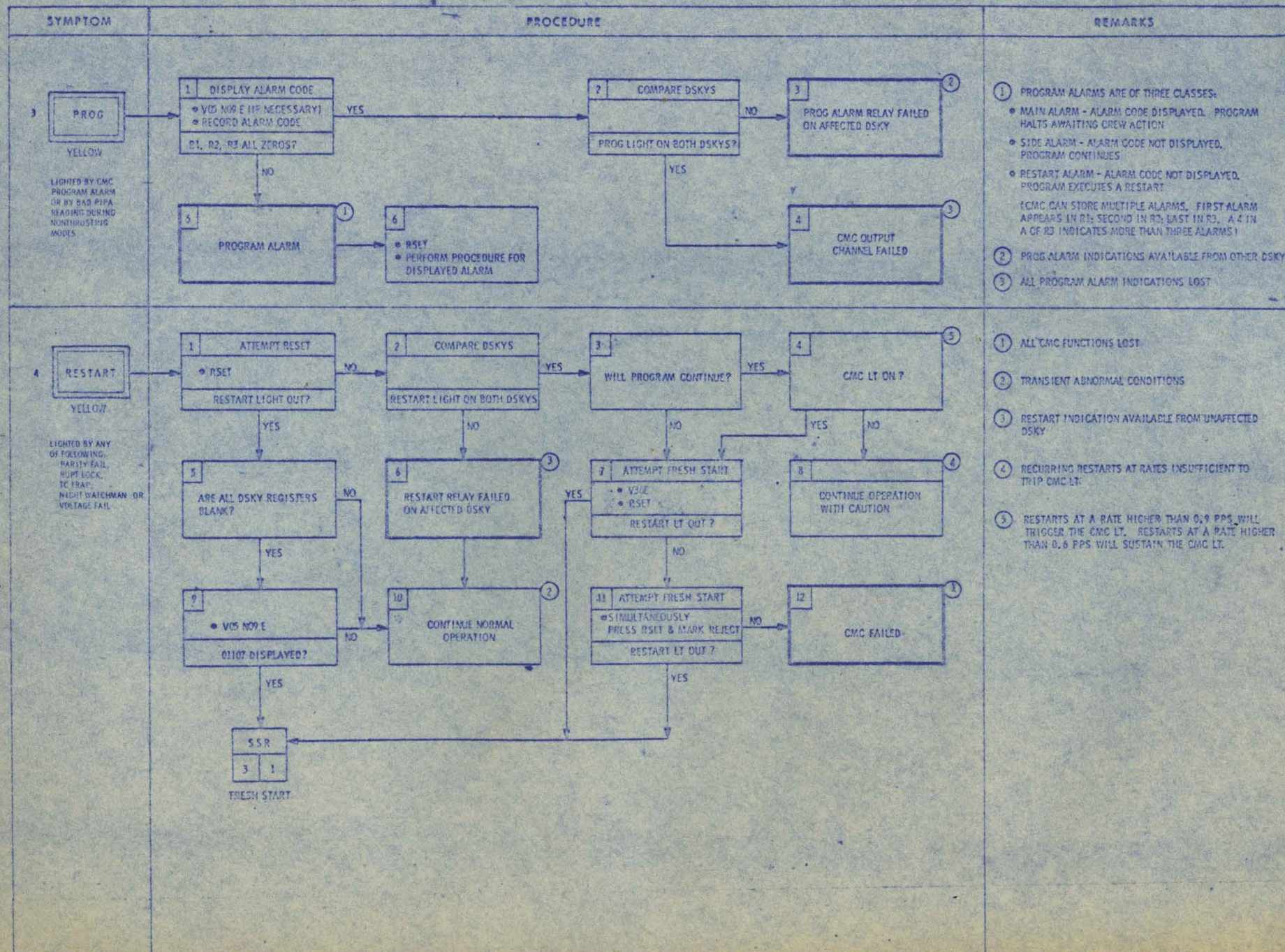


Table 6-4. Malfunction Procedures







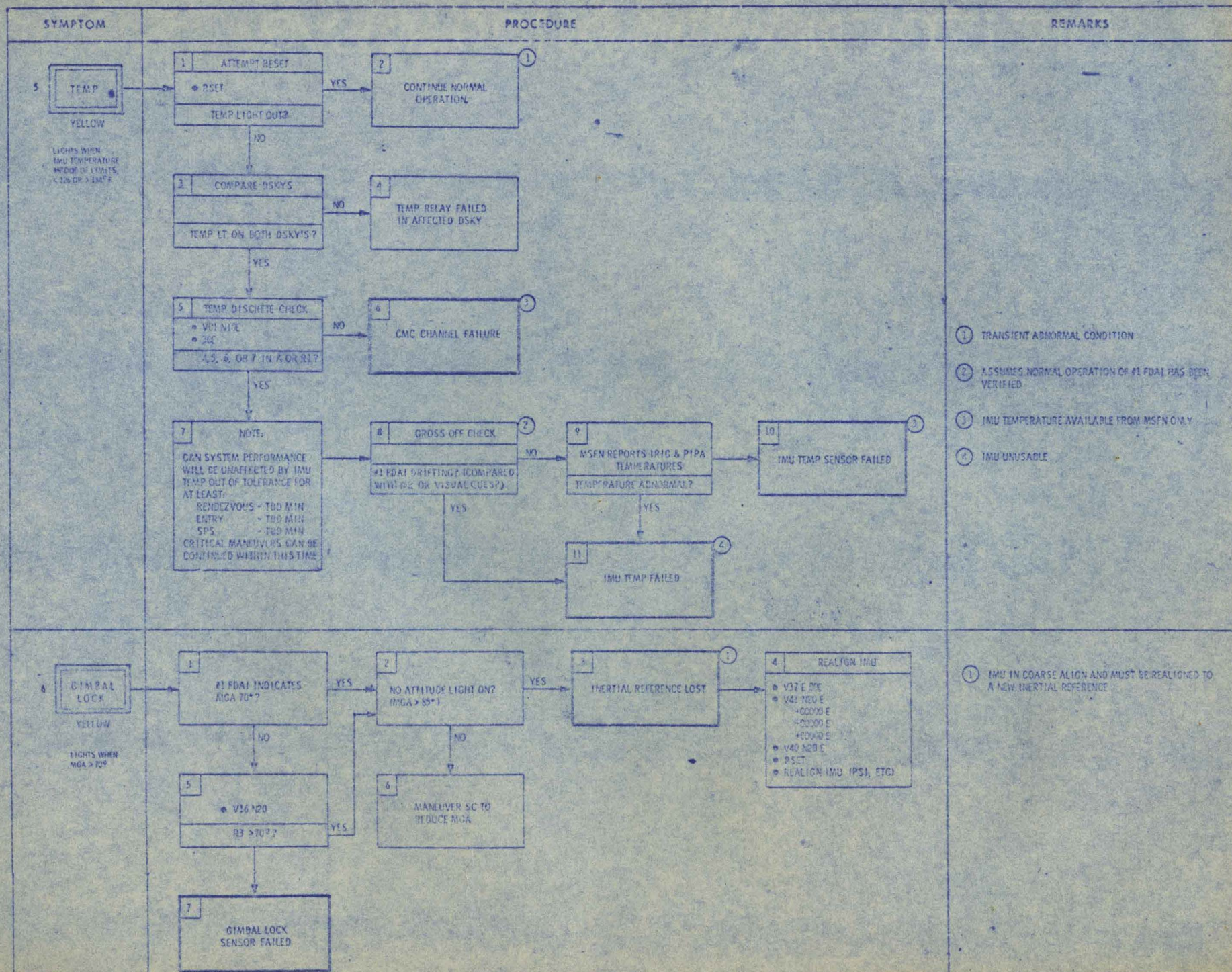


Table 6-1

Malfunction Procedures

(Sheet 4 of 12)



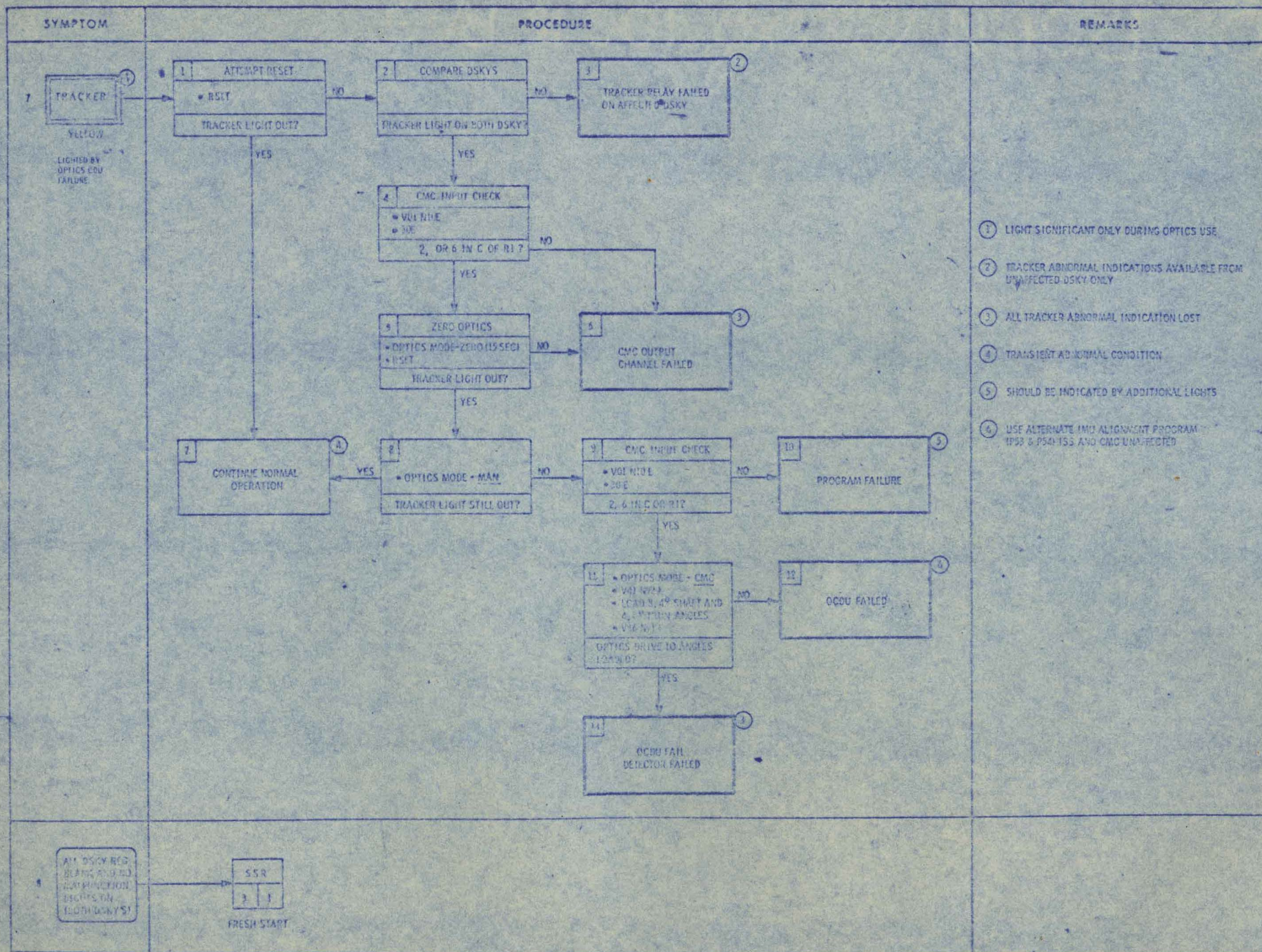
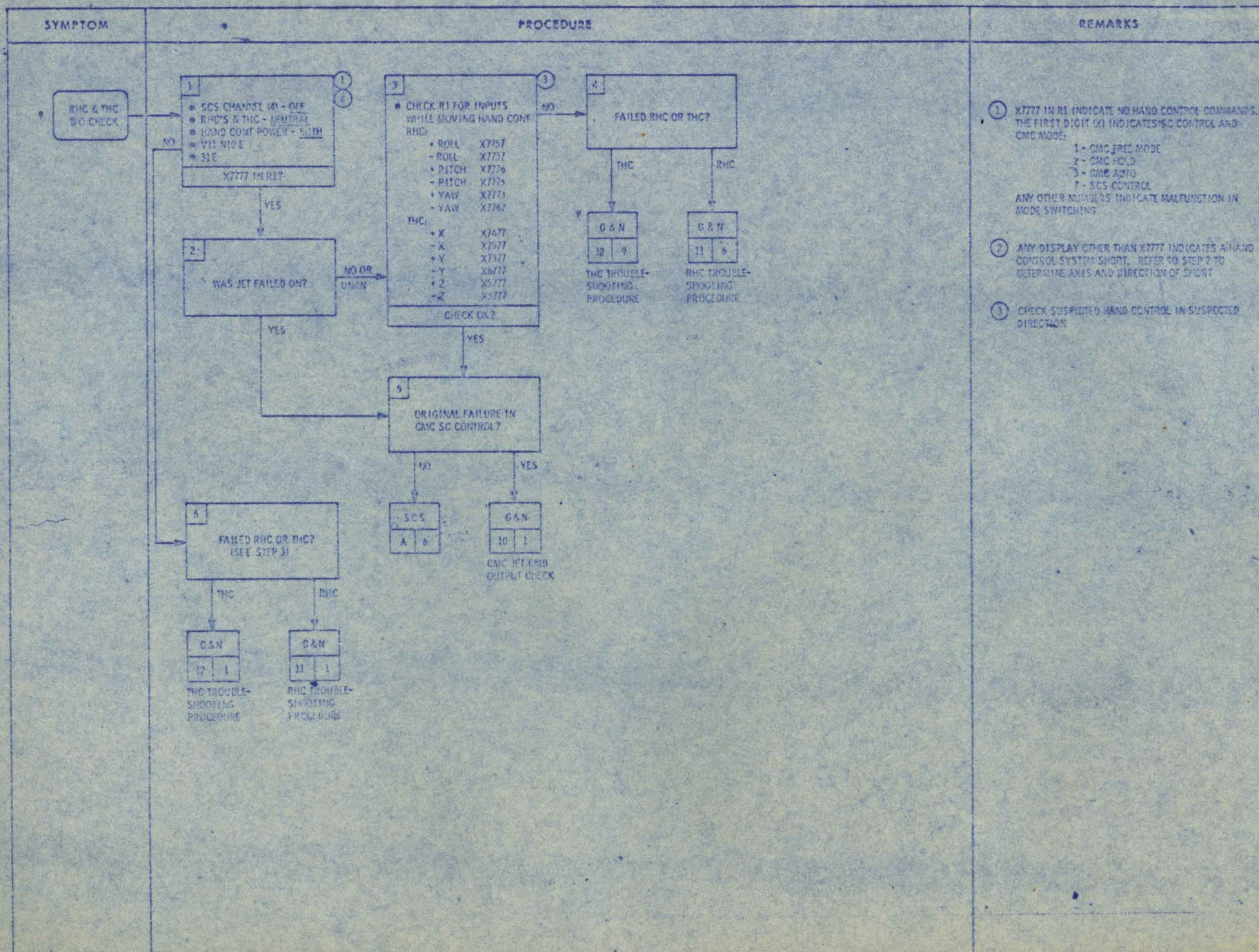


Table 6-4

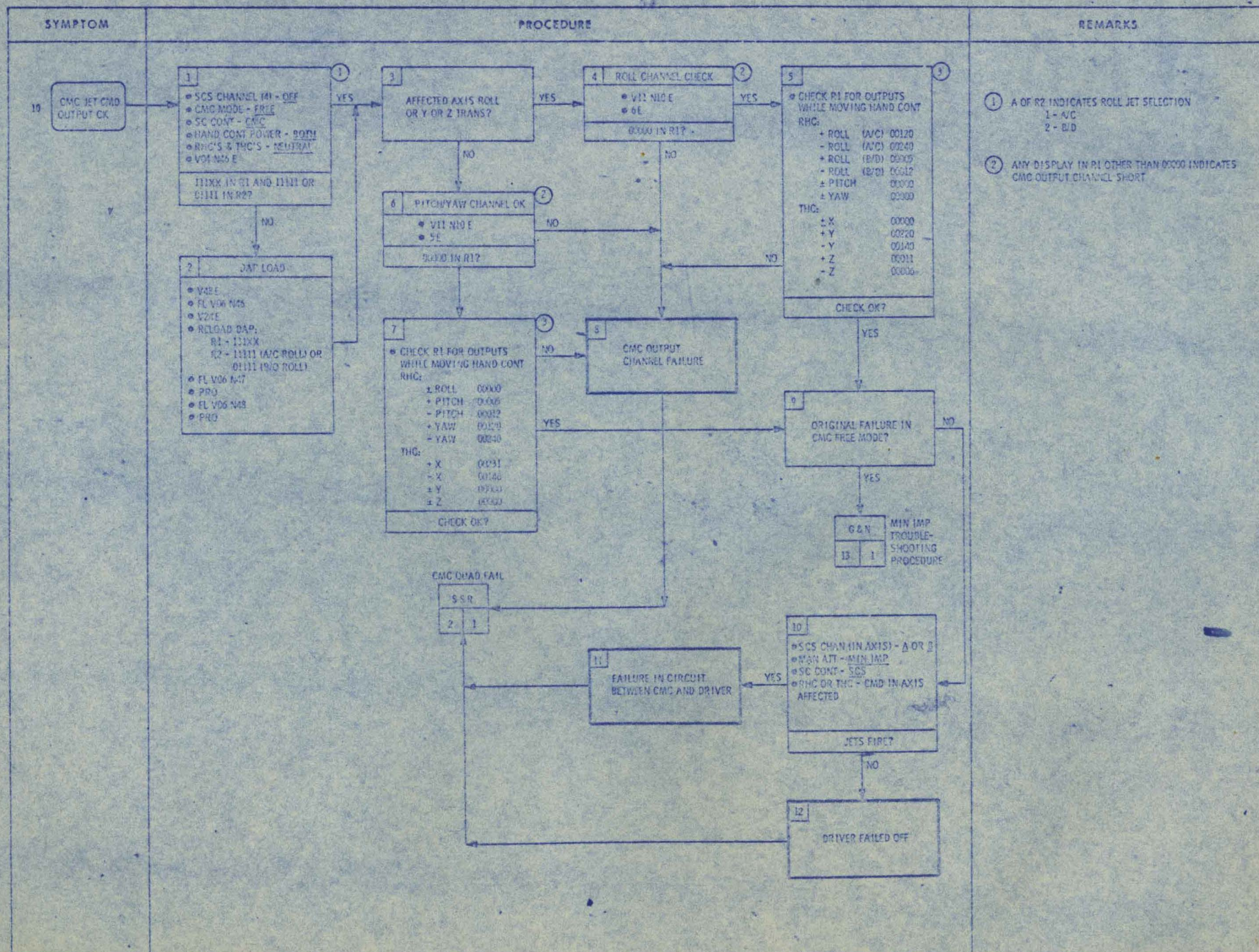
Malfunction Procedures

(Sheet 3 of 12)





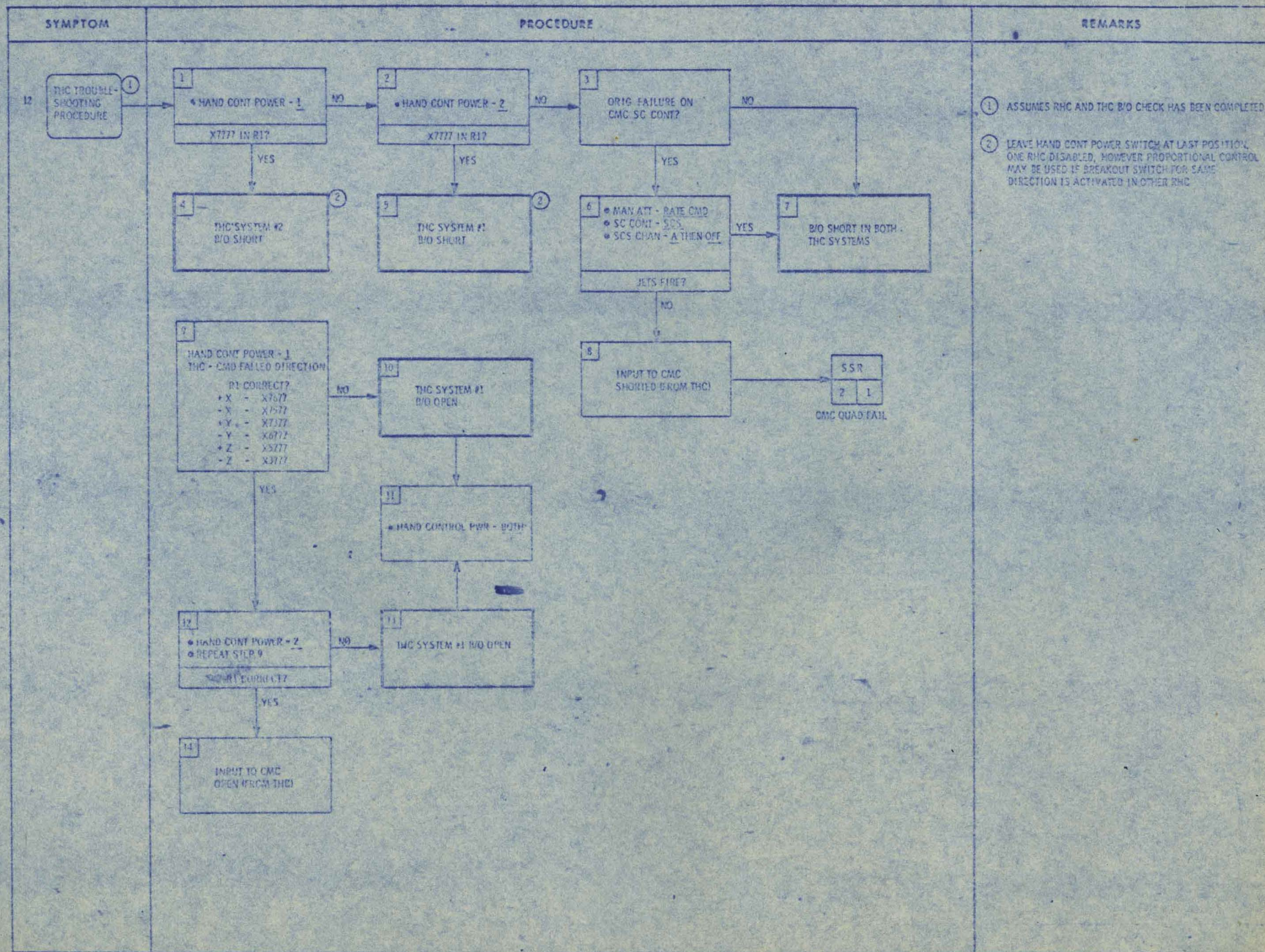






SYMPTOM	PROCEDURE	REMARKS
<p>11 RHC TROUBLE-SHOOTING PROCEDURE</p>	<pre> graph TD     Start([11 RHC TROUBLE-SHOOTING PROCEDURE]) -- 1 --&gt; Step1[1 HAND CONT POWER - 1 X777 IN R12]     Step1 -- NO --&gt; Step2[2 HAND CONT POWER - 2 X777 IN R12]     Step1 -- YES --&gt; Step4[4 RHC #2 BREAKOUT SHORT]     Step2 -- NO --&gt; Step3[3 INPUT TO CMC SHORTED (FROM RHC'S)]     Step2 -- YES --&gt; Step5[5 RHC #1 BREAKOUT SHORT]     Step3 --&gt; SSR[SSR 2 1 CMC QUAD FAIL]     Step4 --&gt; Step6[6 ALT RHC - CMC FAILED DIRECTION - ROLL X7757 - ROLL X7737 - PITCH X7776 - PITCH X7775 - YAW X7773 - YAW X7767]     Step5 --&gt; Step7[7 INPUT TO CMC OPEN FROM RHC'S]     Step6 -- NO --&gt; Step7     Step6 -- YES --&gt; Step8[8 BREAKOUT OPEN IN ORIG RHC]     </pre>	<p>① ASSUMES RHC AND THC B/O CHECK HAS BEEN COMPLETED</p> <p>② LEAVE HAND CONT POWER SWITCH AT LAST POSITION TO ISOLATE FAILED RHC</p>





6-31



SYMPTOM	PROCEDURE	REMARKS
<p>MIN IMP TROUBLE- SHOOTING PROCEDURE</p>	<pre> graph TD     Start([1]) --&gt; Box1[1 • SOS CHAN 41 - OFF • RHC'S &amp; THC - NEUTRAL • OMC MODE - FREE • SO CONT - OMC • VIL R10 E • 32 E 7777 IN R1?]     Box1 -- YES --&gt; Box2[2 • CHECK R1 FOR INPUTS WHILE MOVING MIN IMP CONTROL: • ROLL 7757 • ROLL 7757 • PITCH 7776 • PITCH 7775 • YAW 7773 • YAW 7767 CHECK OK?]     Box1 -- NO --&gt; Box5[5 MIN IMP CONTROL SHORTED IN AFFECTED AXES]     Box2 -- YES --&gt; Box3[3 G &amp; N 10 10 OUTPUT CHAN CHECK]     Box2 -- NO --&gt; Box4[4 MIN IMP CONTROL OPEN IN AFFECTED AXES]   </pre>	<p>① ASSUMES INPUT CHANNEL CHECK HAS BEEN COMPLETED</p> <p>② 7777 IN R1 INDICATES NO MINIMUM IMPULSE COMMANDS</p> <p>③ DO NOT USE MINIMUM IMPULSE CONTROL</p> <p>④ MINIMUM IMPULSE CONTROL LOST IN AFFECTED DIRECTION ONLY. MAY BE USED IN OTHER AXES AND DIRECTION</p>



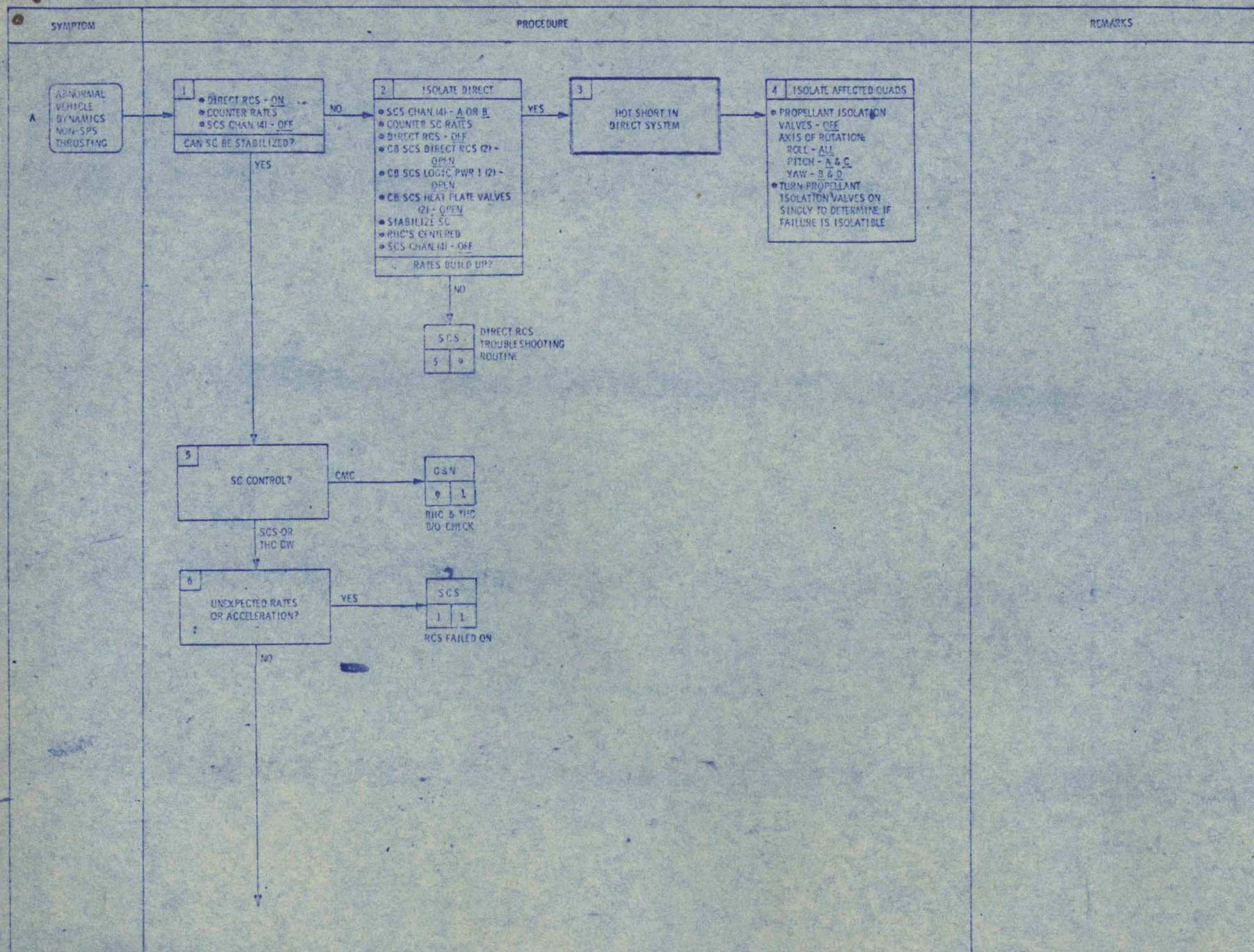
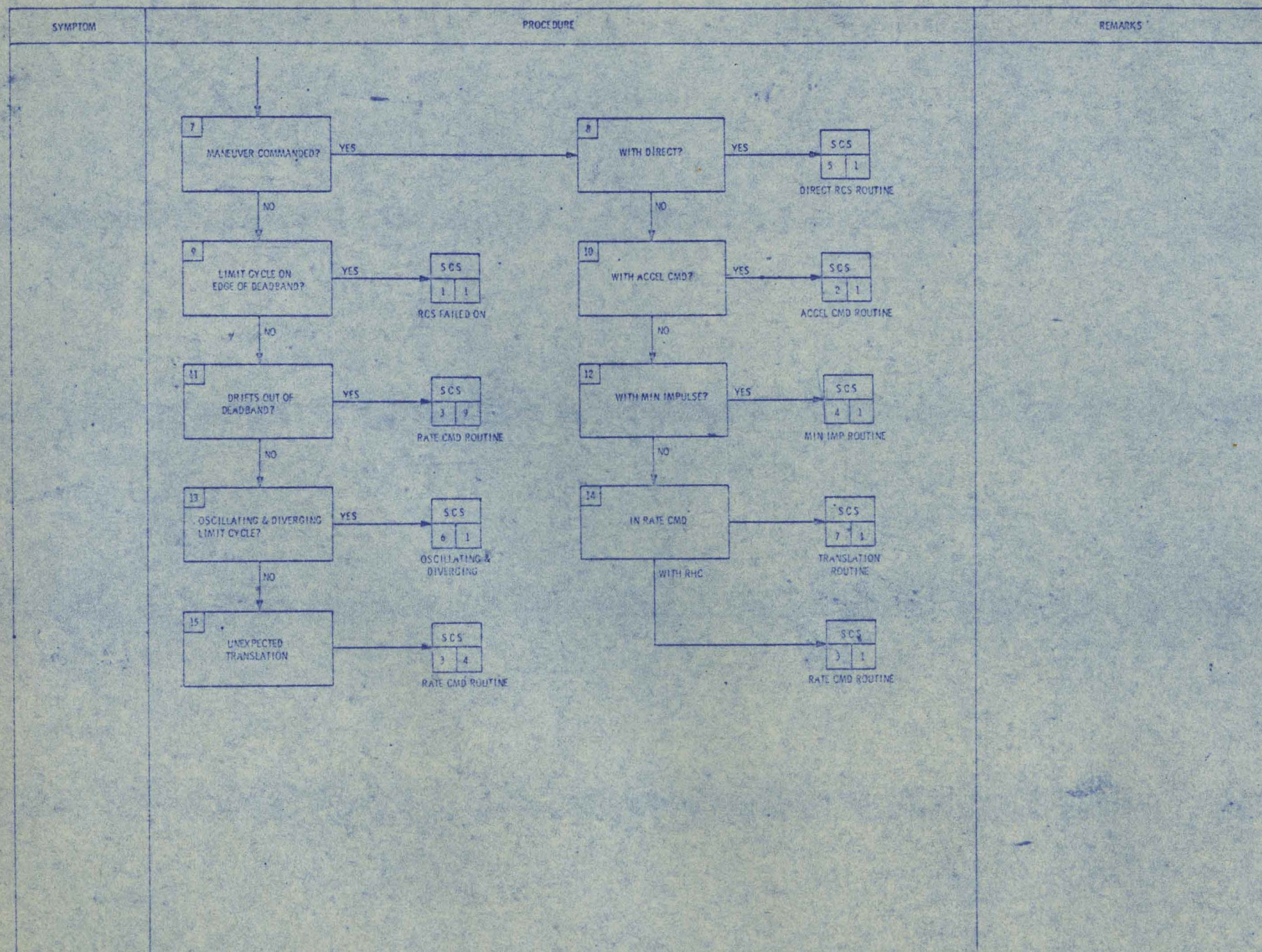


Table 6-4

Malfunction Procedures

(Sheet 11 of 12)







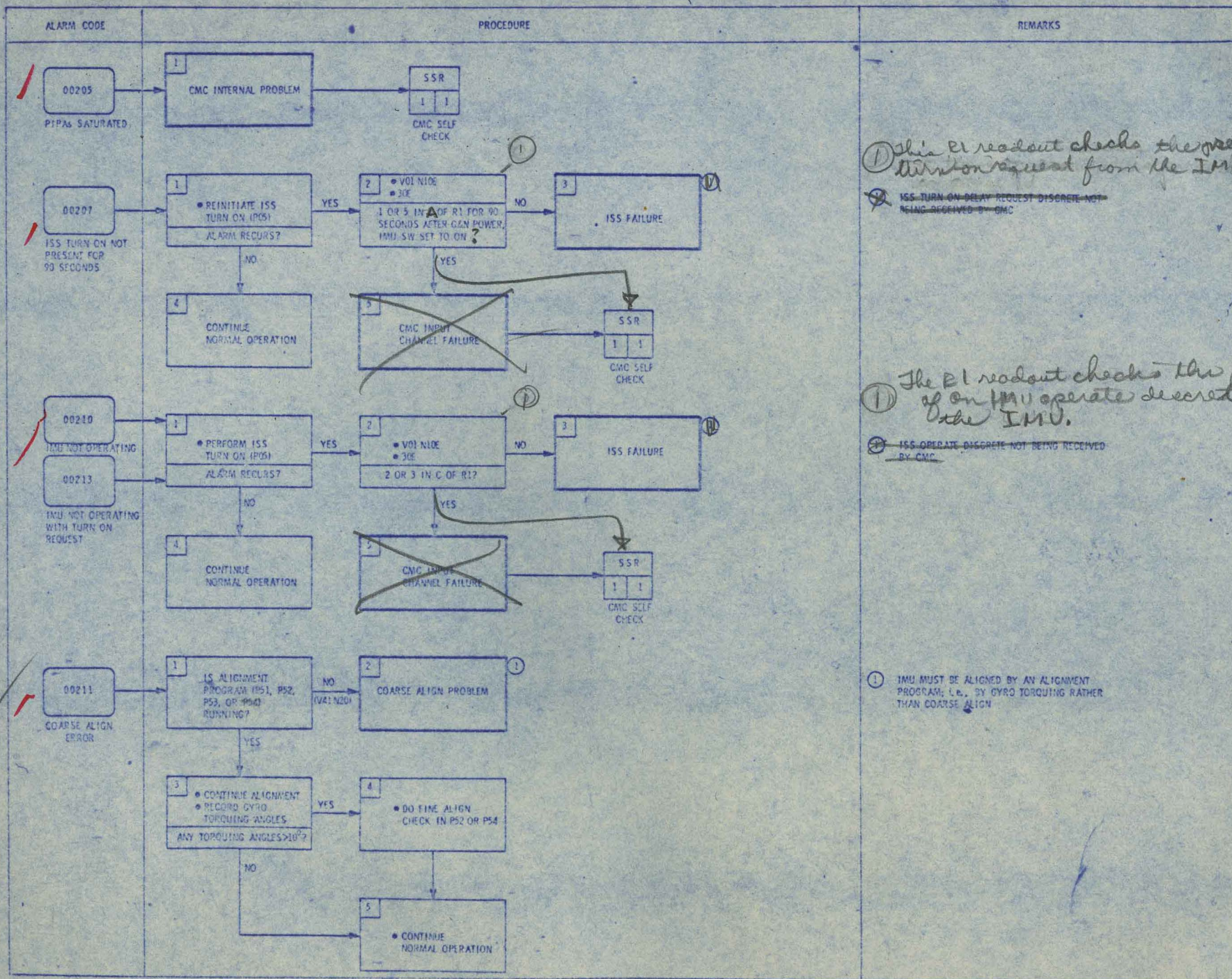
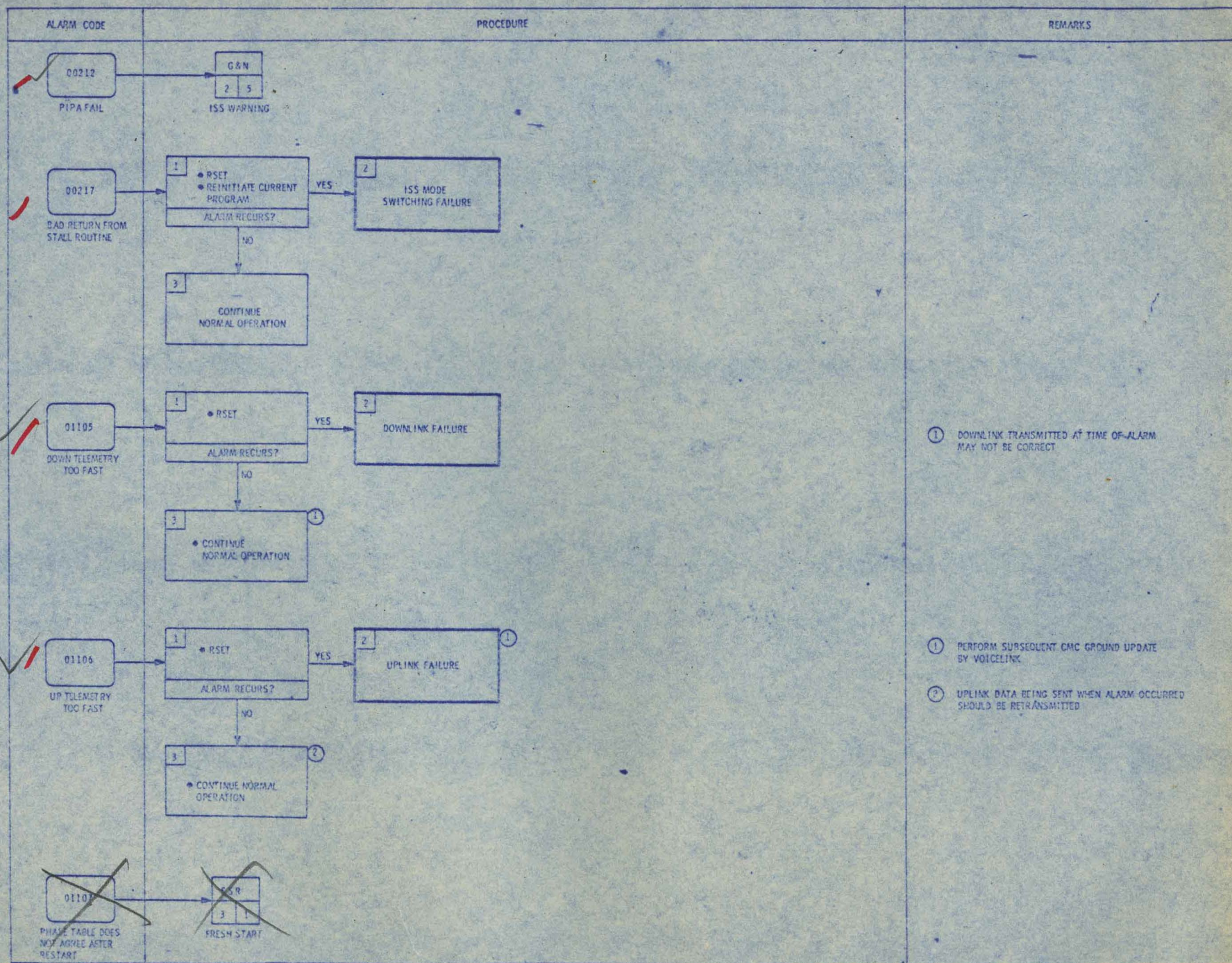


Table 6-5





6-36

Table 6-5

Program Alarm Procedures

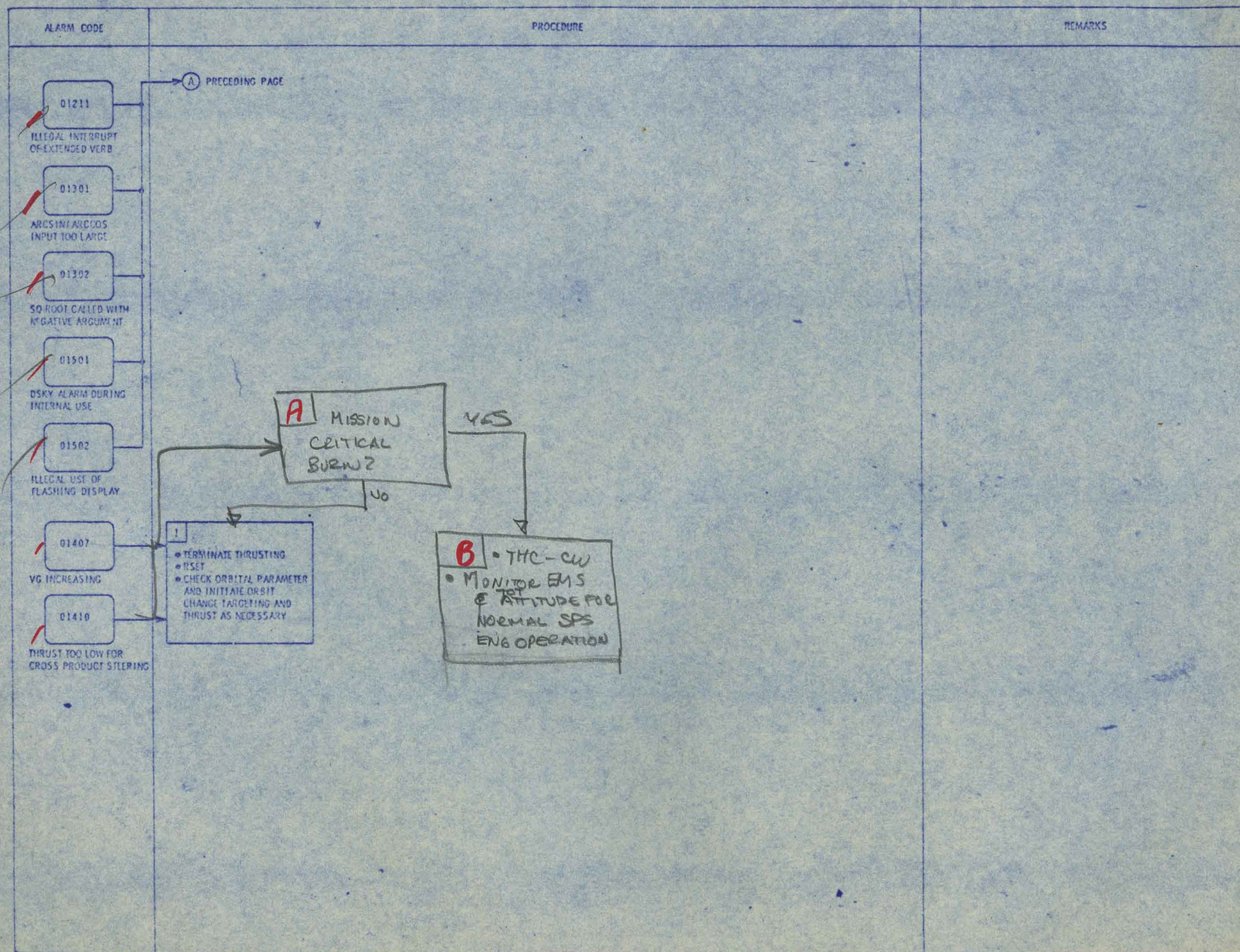
(Sheet 2 of 4)



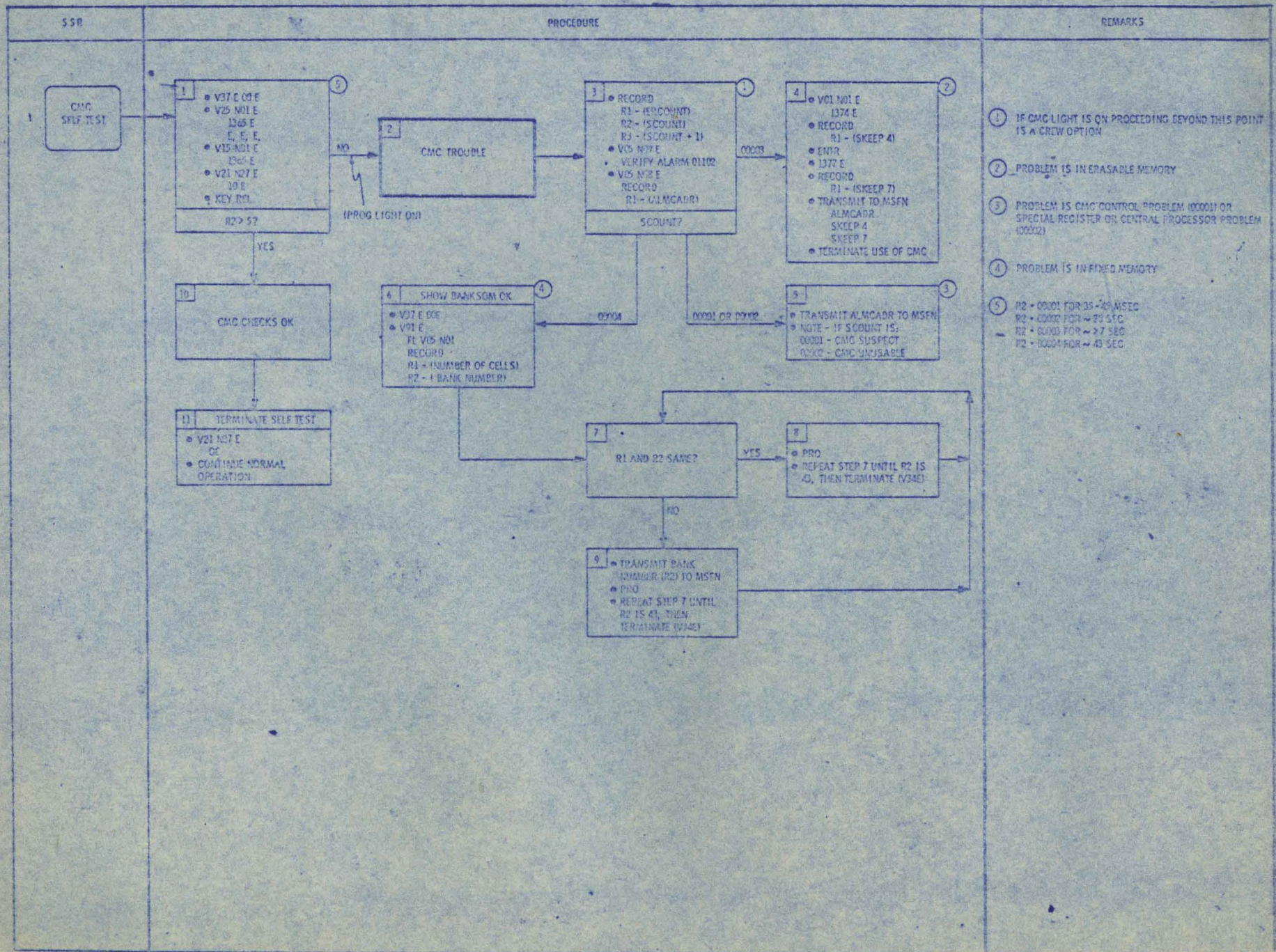
5-37

ALARM CODE	PROCEDURE	REMARKS
<div>01103</div> <div>UNUSED CCS BRANCH EXECUTED</div> <div>01104</div> <div>DELAY ROUTINE BUSY</div> <div>01110</div> <div>RESTART WITH NO ACTIVE PHASE</div> <div>01201</div> <div>NO VAC AREAS AVAILABLE</div> <div>01202</div> <div>NO CORE SETS AVAILABLE</div> <div>01203</div> <div>WAITLIST OVERFLOW</div> <div>01206</div> <div>200 JOB ATTEMPTS TO GO TO SLEEP VIA USKY PROGRAM</div> <div>01207</div> <div>NO VAC AREAS AVAILABLE FOR MARKS</div> <div>01210</div> <div>2 PROG TRYING TO USE SAME DEVICE</div>	<pre> graph TD     A((A)) --&gt; B1[1]     B1[1] --&gt; B2[2]     B2[2] --&gt; B3[3]     B3[3] --&gt; B4[4]     B4[4] --&gt; B5[5]     B5[5] --&gt; B6[6]     B6[6] --&gt; B7[7]     B7[7] --&gt; B8[8]     B8[8] --&gt; B9[9]     B9[9] --&gt; B10[10]     B10[10] --&gt; B11[11]     B11[11] --&gt; B12[12]     B12[12] --&gt; B13[13]     B13[13] --&gt; B14[14]     B14[14] --&gt; B15[15]     B15[15] --&gt; B16[16]     B16[16] --&gt; B17[17]     B17[17] --&gt; B18[18]     B18[18] --&gt; B19[19]     B19[19] --&gt; B20[20]     B20[20] --&gt; B21[21]     B21[21] --&gt; B22[22]     B22[22] --&gt; B23[23]     B23[23] --&gt; B24[24]     B24[24] --&gt; B25[25]     B25[25] --&gt; B26[26]     B26[26] --&gt; B27[27]     B27[27] --&gt; B28[28]     B28[28] --&gt; B29[29]     B29[29] --&gt; B30[30]     B30[30] --&gt; B31[31]     B31[31] --&gt; B32[32]     B32[32] --&gt; B33[33]     B33[33] --&gt; B34[34]     B34[34] --&gt; B35[35]     B35[35] --&gt; B36[36]     B36[36] --&gt; B37[37]     B37[37] --&gt; B38[38]     B38[38] --&gt; B39[39]     B39[39] --&gt; B40[40]     B40[40] --&gt; B41[41]     B41[41] --&gt; B42[42]     B42[42] --&gt; B43[43]     B43[43] --&gt; B44[44]     B44[44] --&gt; B45[45]     B45[45] --&gt; B46[46]     B46[46] --&gt; B47[47]     B47[47] --&gt; B48[48]     B48[48] --&gt; B49[49]     B49[49] --&gt; B50[50]     B50[50] --&gt; B51[51]     B51[51] --&gt; B52[52]     B52[52] --&gt; B53[53]     B53[53] --&gt; B54[54]     B54[54] --&gt; B55[55]     B55[55] --&gt; B56[56]     B56[56] --&gt; B57[57]     B57[57] --&gt; B58[58]     B58[58] --&gt; B59[59]     B59[59] --&gt; B60[60]     B60[60] --&gt; B61[61]     B61[61] --&gt; B62[62]     B62[62] --&gt; B63[63]     B63[63] --&gt; B64[64]     B64[64] --&gt; B65[65]     B65[65] --&gt; B66[66]     B66[66] --&gt; B67[67]     B67[67] --&gt; B68[68]     B68[68] --&gt; B69[69]     B69[69] --&gt; B70[70]     B70[70] --&gt; B71[71]     B71[71] --&gt; B72[72]     B72[72] --&gt; B73[73]     B73[73] --&gt; B74[74]     B74[74] --&gt; B75[75]     B75[75] --&gt; B76[76]     B76[76] --&gt; B77[77]     B77[77] --&gt; B78[78]     B78[78] --&gt; B79[79]     B79[79] --&gt; B80[80]     B80[80] --&gt; B81[81]     B81[81] --&gt; B82[82]     B82[82] --&gt; B83[83]     B83[83] --&gt; B84[84]     B84[84] --&gt; B85[85]     B85[85] --&gt; B86[86]     B86[86] --&gt; B87[87]     B87[87] --&gt; B88[88]     B88[88] --&gt; B89[89]     B89[89] --&gt; B90[90]     B90[90] --&gt; B91[91]     B91[91] --&gt; B92[92]     B92[92] --&gt; B93[93]     B93[93] --&gt; B94[94]     B94[94] --&gt; B95[95]     B95[95] --&gt; B96[96]     B96[96] --&gt; B97[97]     B97[97] --&gt; B98[98]     B98[98] --&gt; B99[99]     B99[99] --&gt; B100[100]     </pre>	

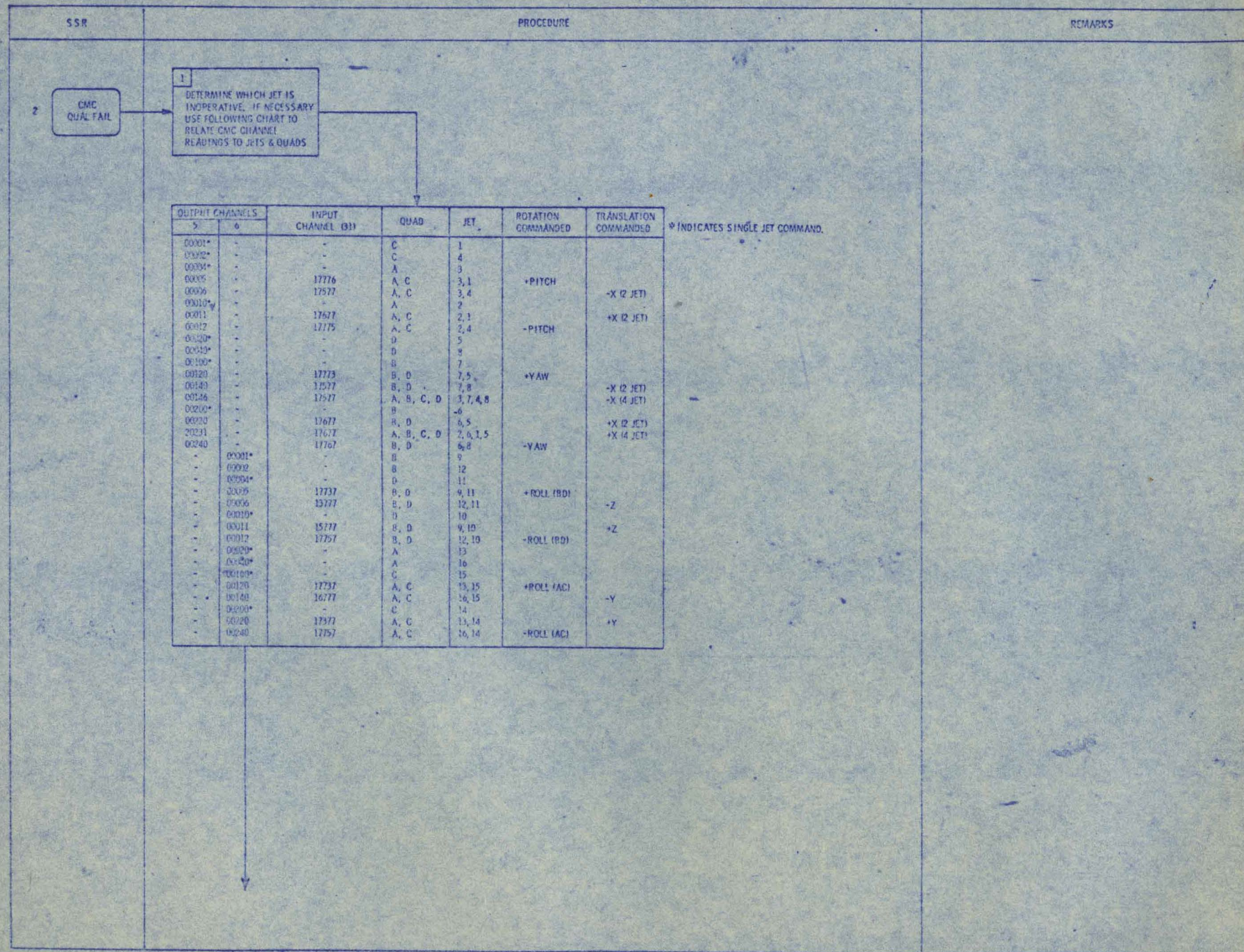




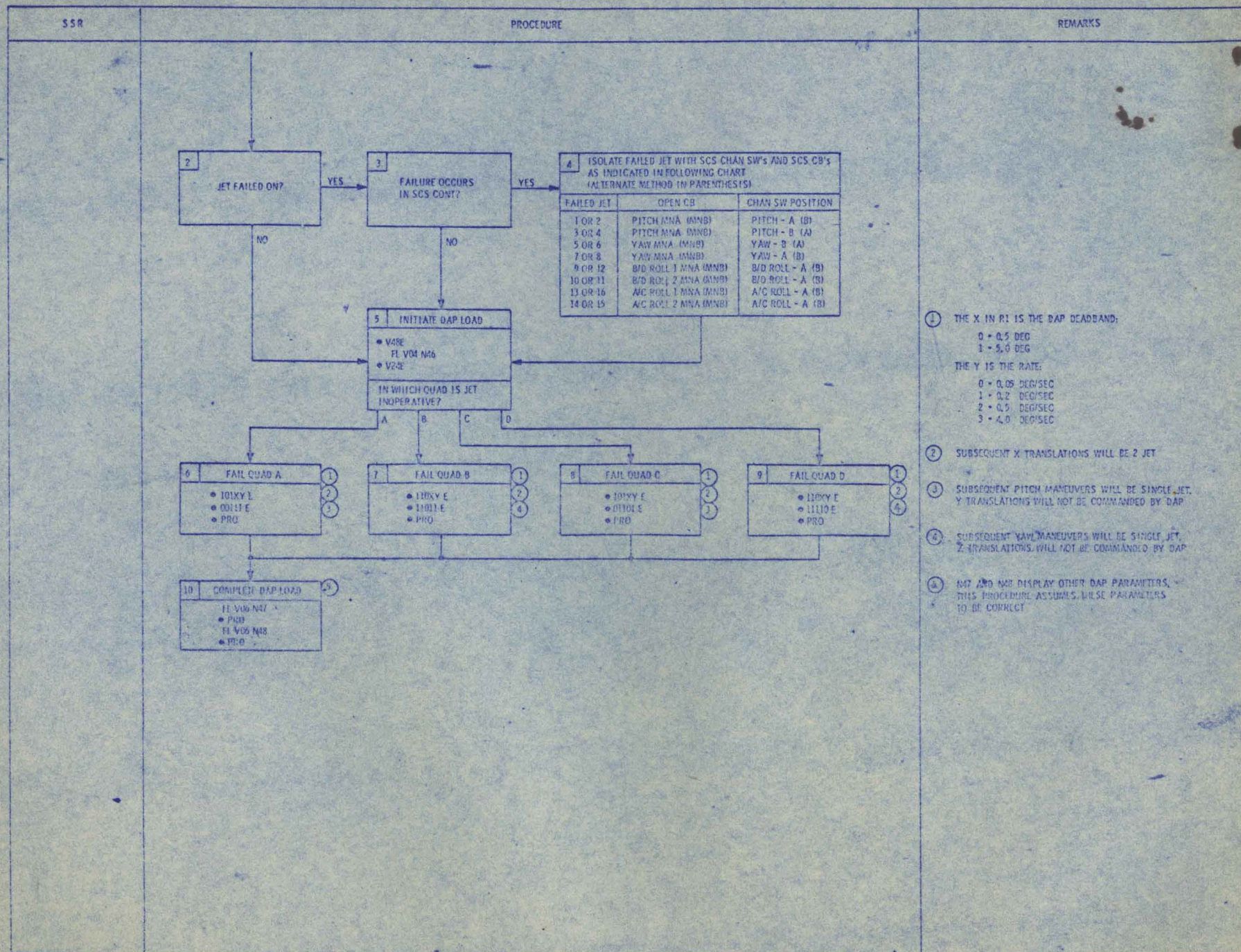




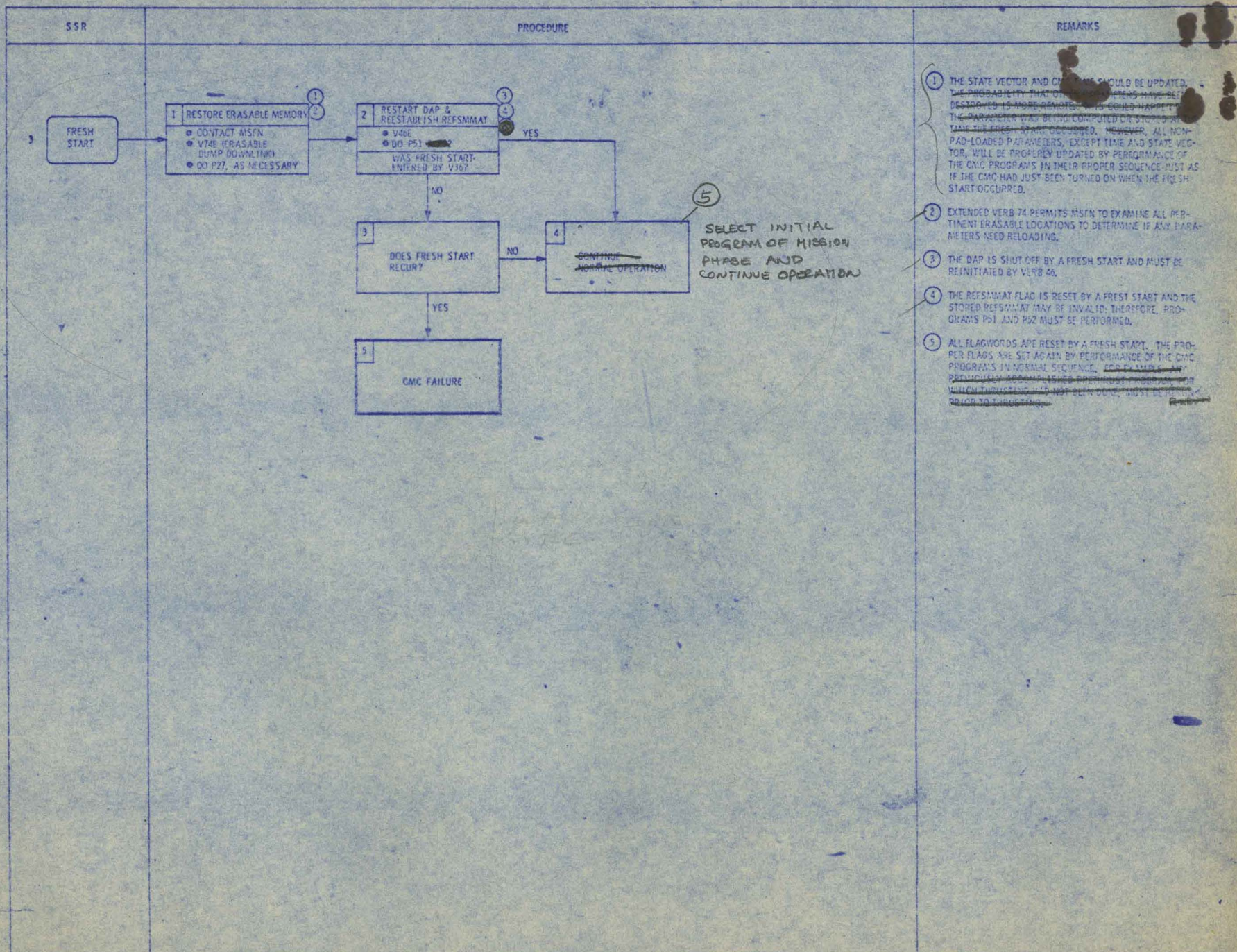






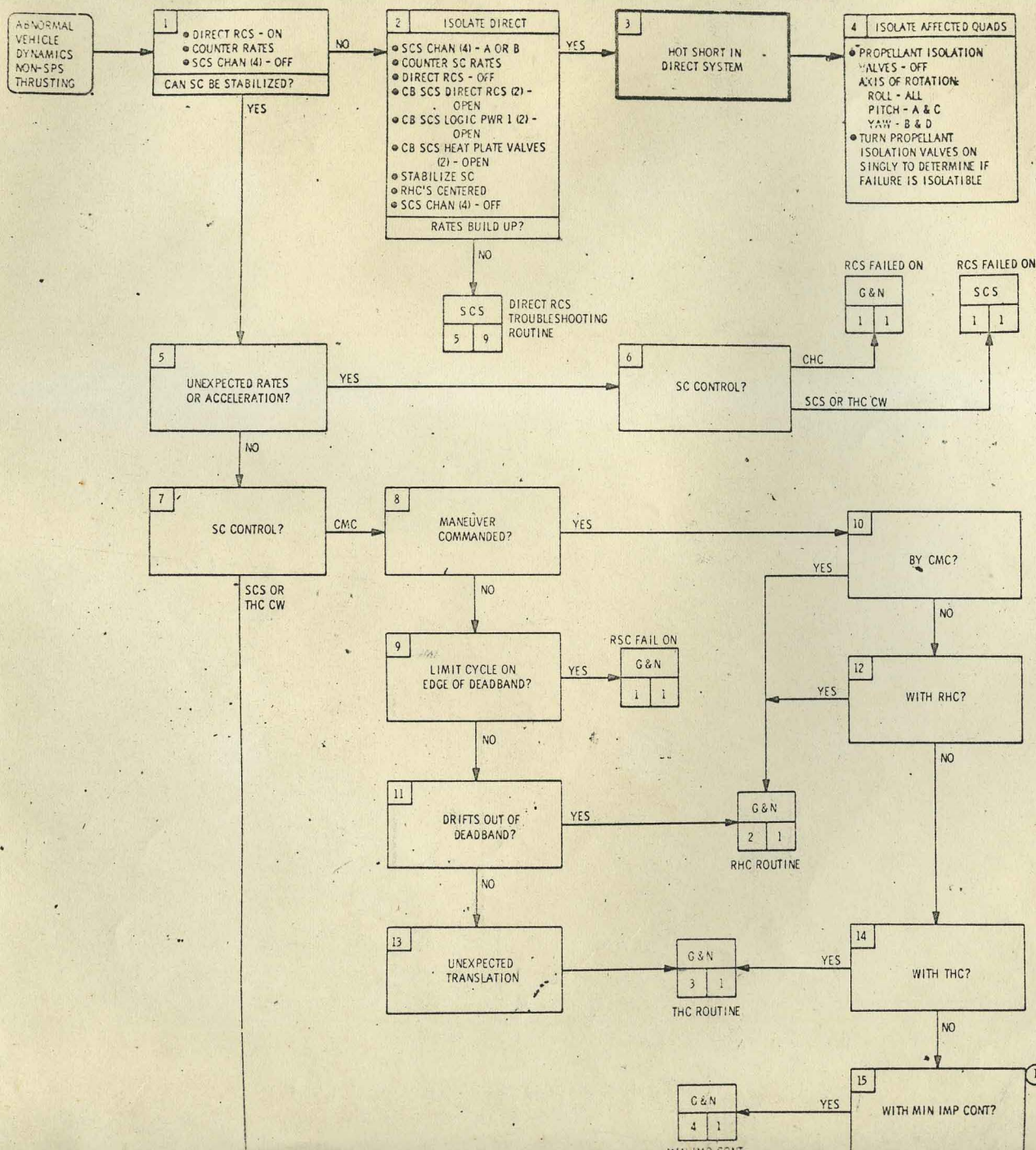






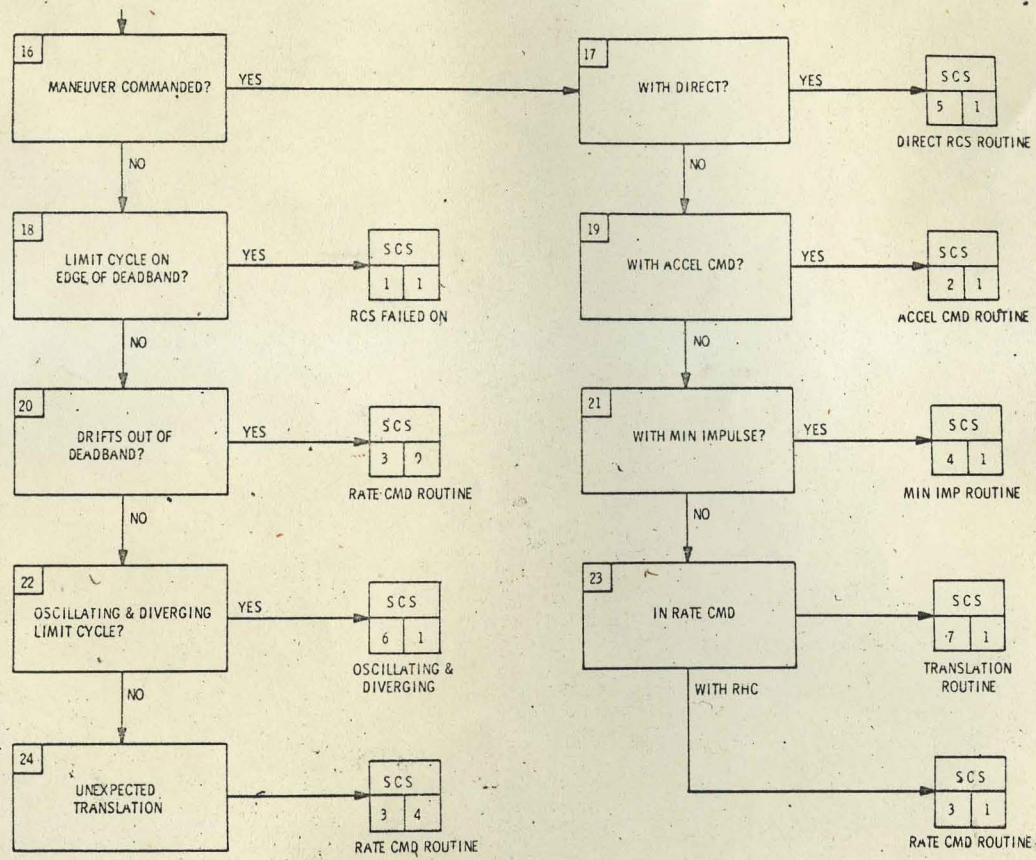


FROM RUSS LARSON 3-1-68  
(TO BE PRESENTED AT G&N SOFTWARE MTR ON 3/2/68 (GEO. MILLER, NASA))

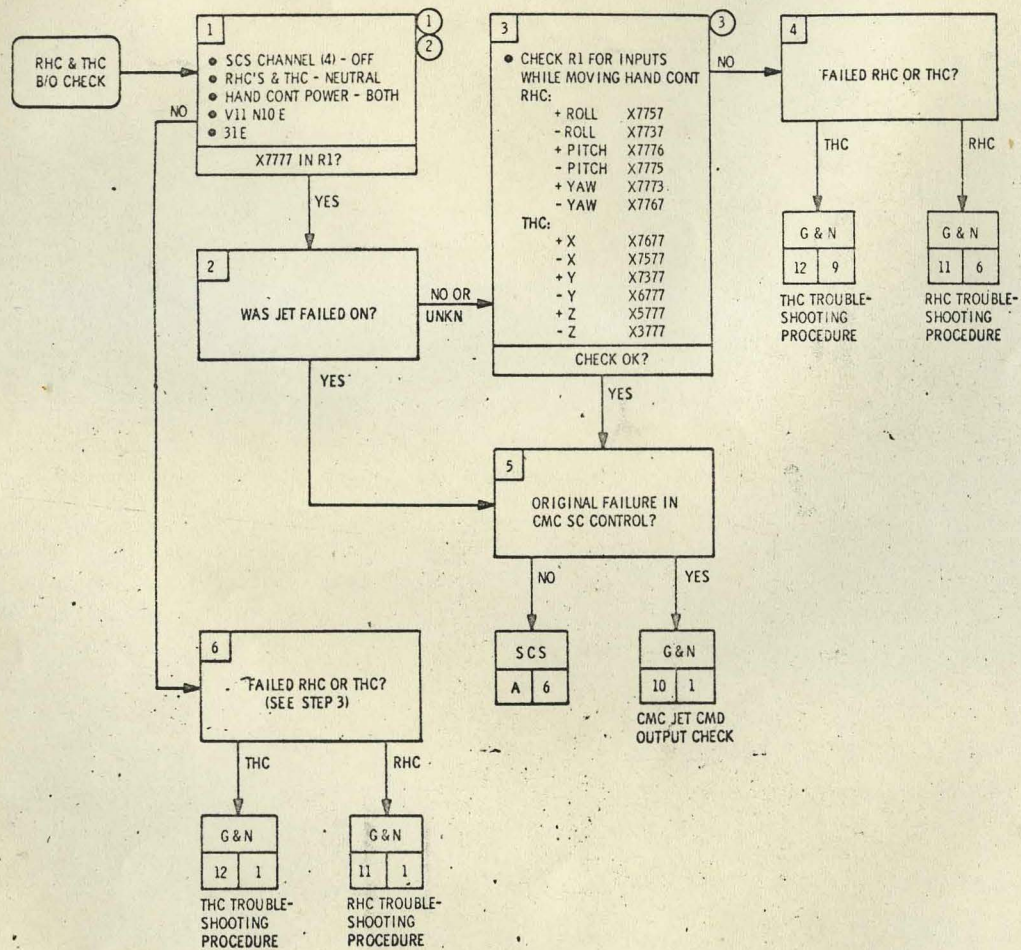


① APPLIES WITH CMC IN FREE MODE ONLY









① X7777 IN R1 INDICATE NO HAND CONTROL COMMANDS. THE FIRST DIGIT (X) INDICATES SC CONTROL AND CMC MODE:

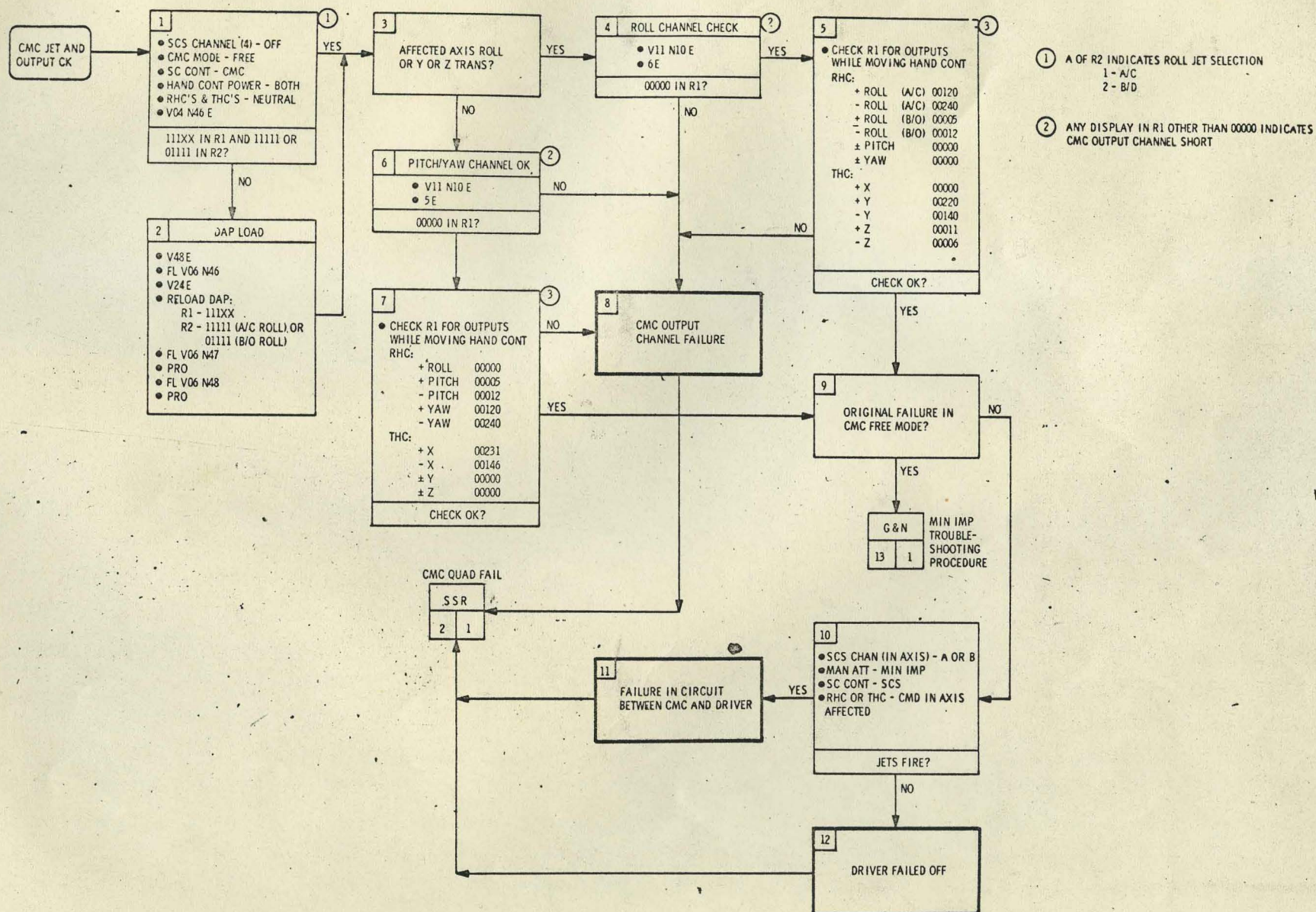
- 1 - CMC FREE MODE
- 2 - CMC HOLD
- 3 - CMC AUTO
- 7 - SCS CONTROL

ANY OTHER NUMBERS INDICATE MALFUNCTION IN MODE SWITCHING

② ANY DISPLAY OTHER THAN X7777 INDICATES A HAND CONTROL SYSTEM SHORT. REFER TO STEP 2 TO DETERMINE AXIS AND DIRECTION OF SHORT

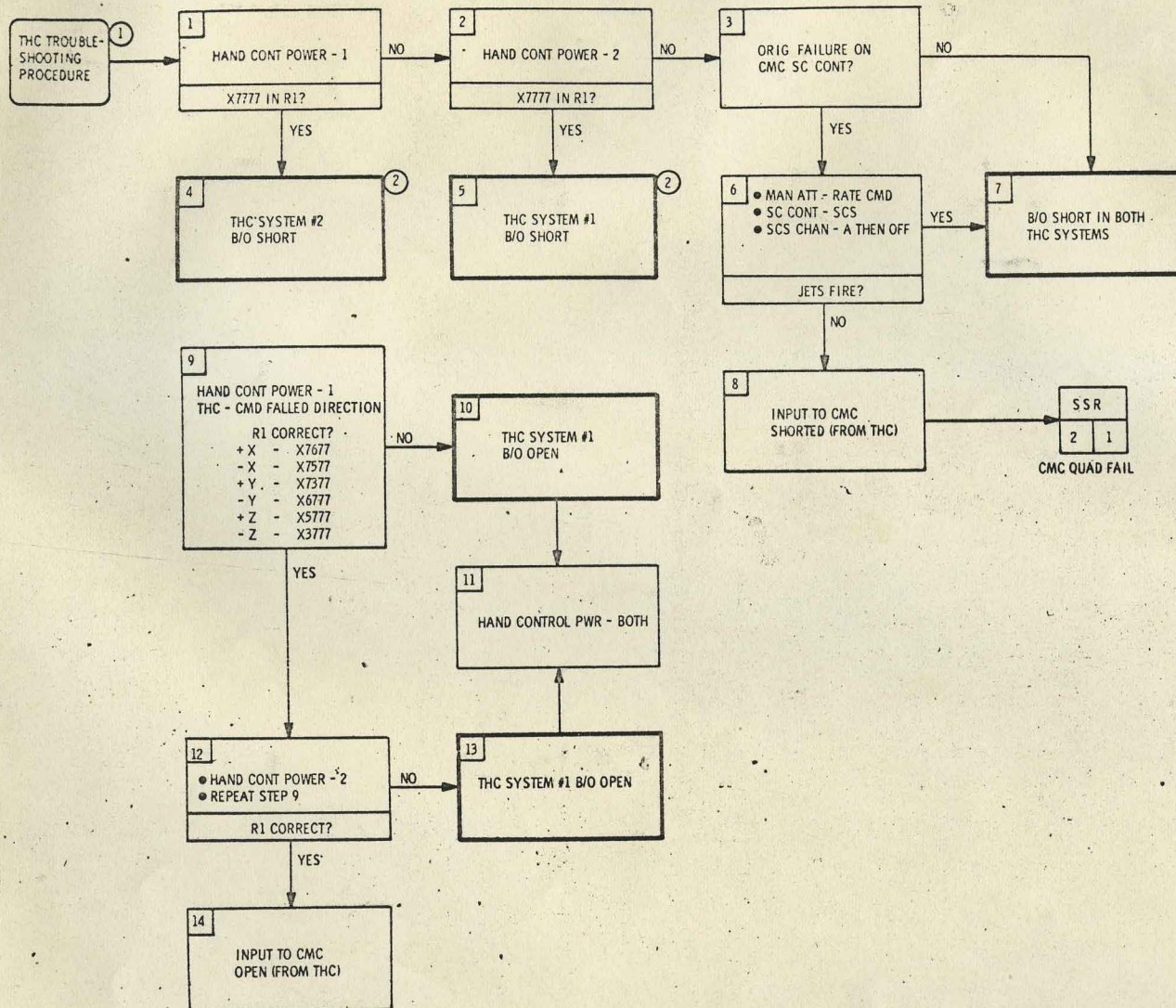
③ CHECK SUSPECTED HAND CONTROL IN SUSPECTED DIRECTION







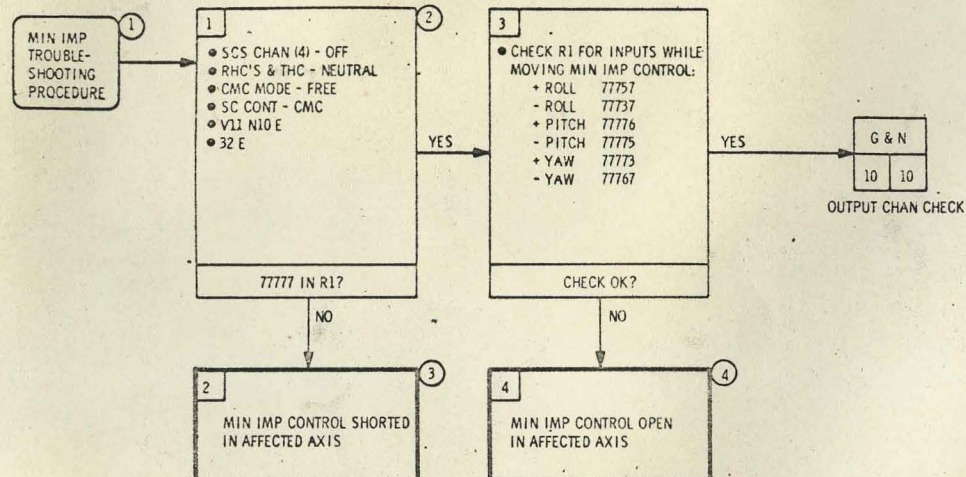
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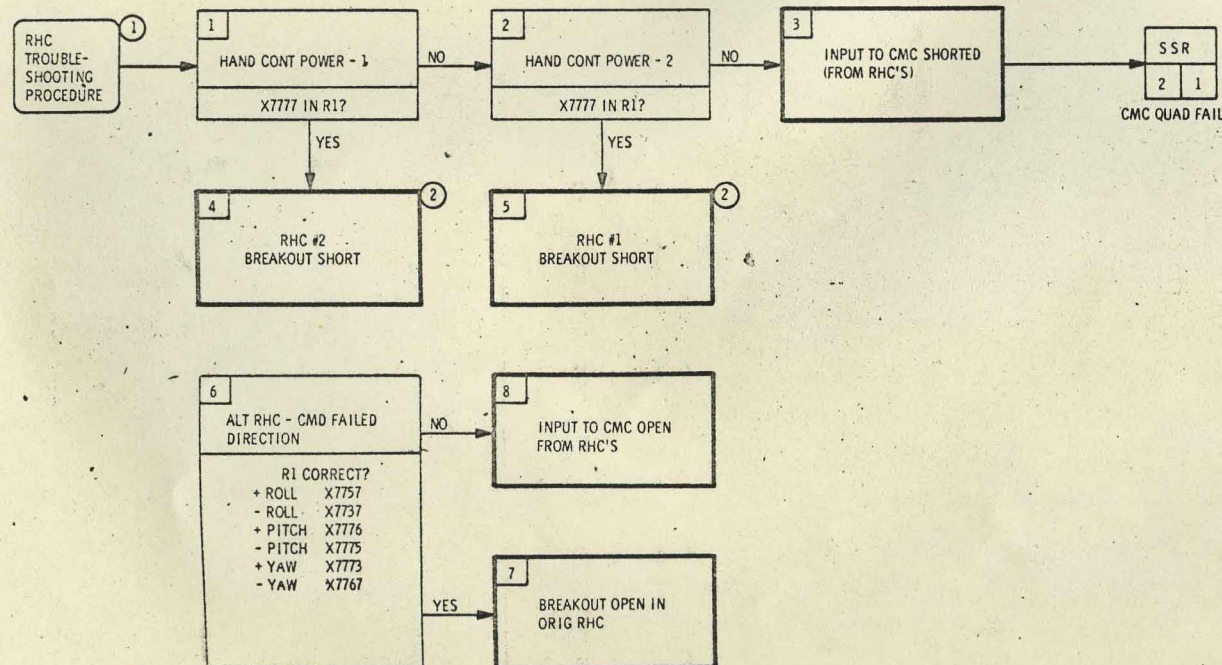
① ASSUMES RHC AND THC B/O CHECK HAS BEEN COMPLETED

② LEAVE HAND CONT POWER SWITCH AT LAST POSITION. ONE RHC DISABLED, HOWEVER PROPORTIONAL CONTROL MAY BE USED IF BREAKOUT SWITCH FOR SAME DIRECTION IS ACTIVATED IN OTHER RHC



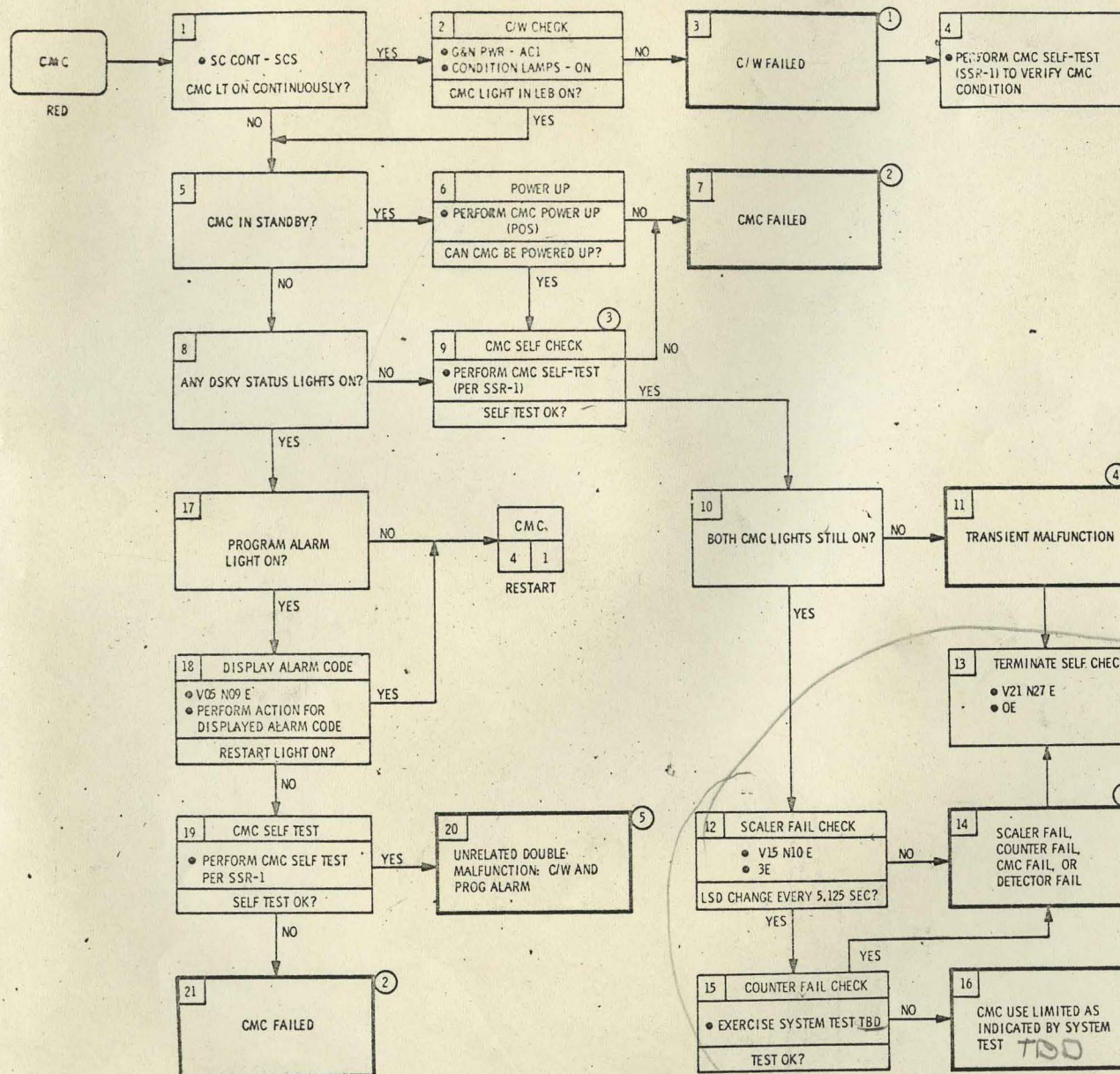


- ① ASSUMES INPUT CHANNEL CHECK HAS BEEN COMPLETED
- ② 7777 IN R1 INDICATES NO MINIMUM IMPULSE COMMANDS
- ③ DO NOT USE MINIMUM IMPULSE CONTROL
- ④ MINIMUM IMPULSE CONTROL LOST IN AFFECTED DIRECTION ONLY. MAY BE USED IN OTHER AXES AND DIRECTION



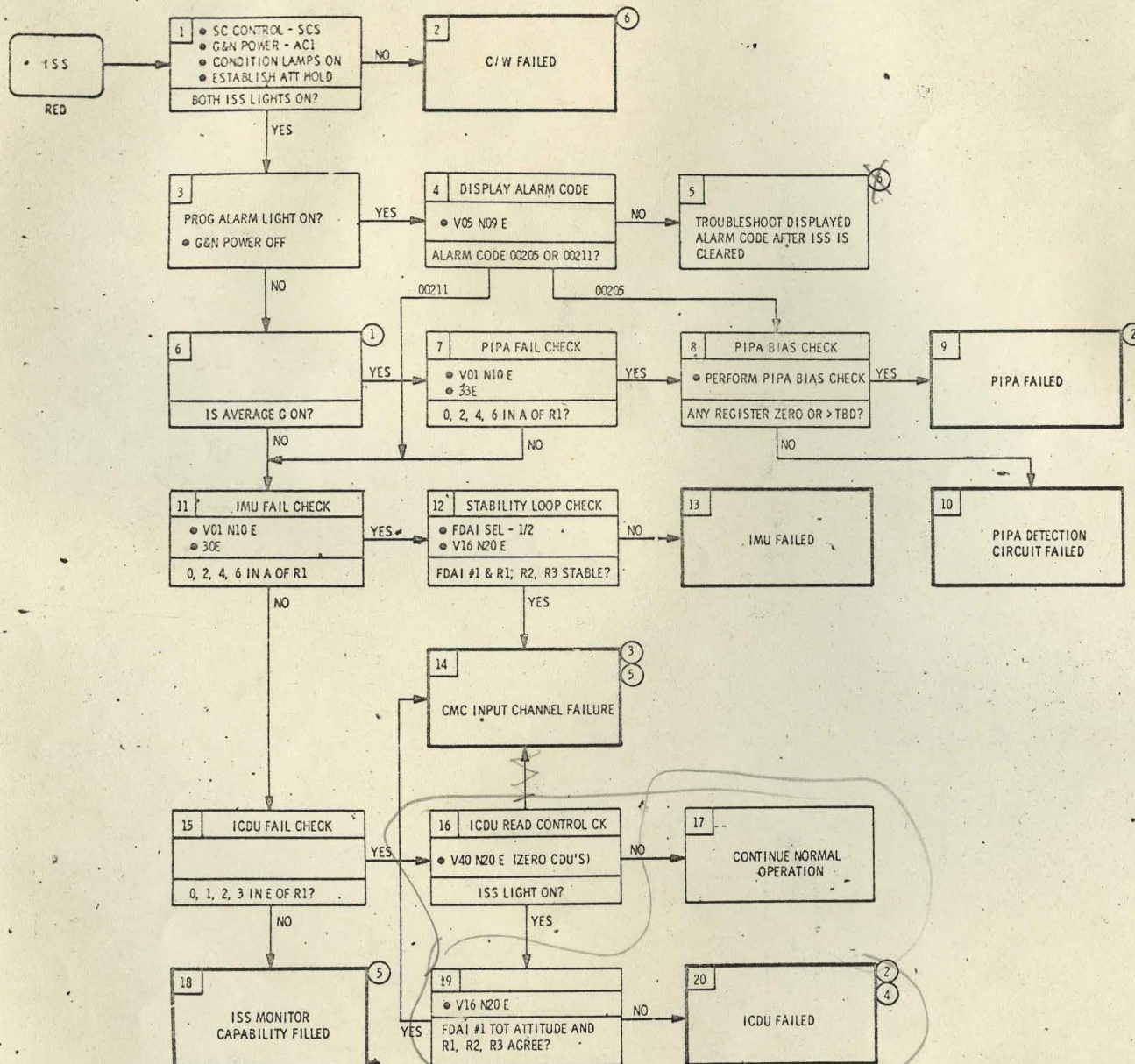
- ① ASSUMES RHC AND THC B/O CHECK HAS BEEN COMPLETED
- ② LEAVE HAND CONT POWER SWITCH AT LAST POSITION TO ISOLATE FAILED RHC





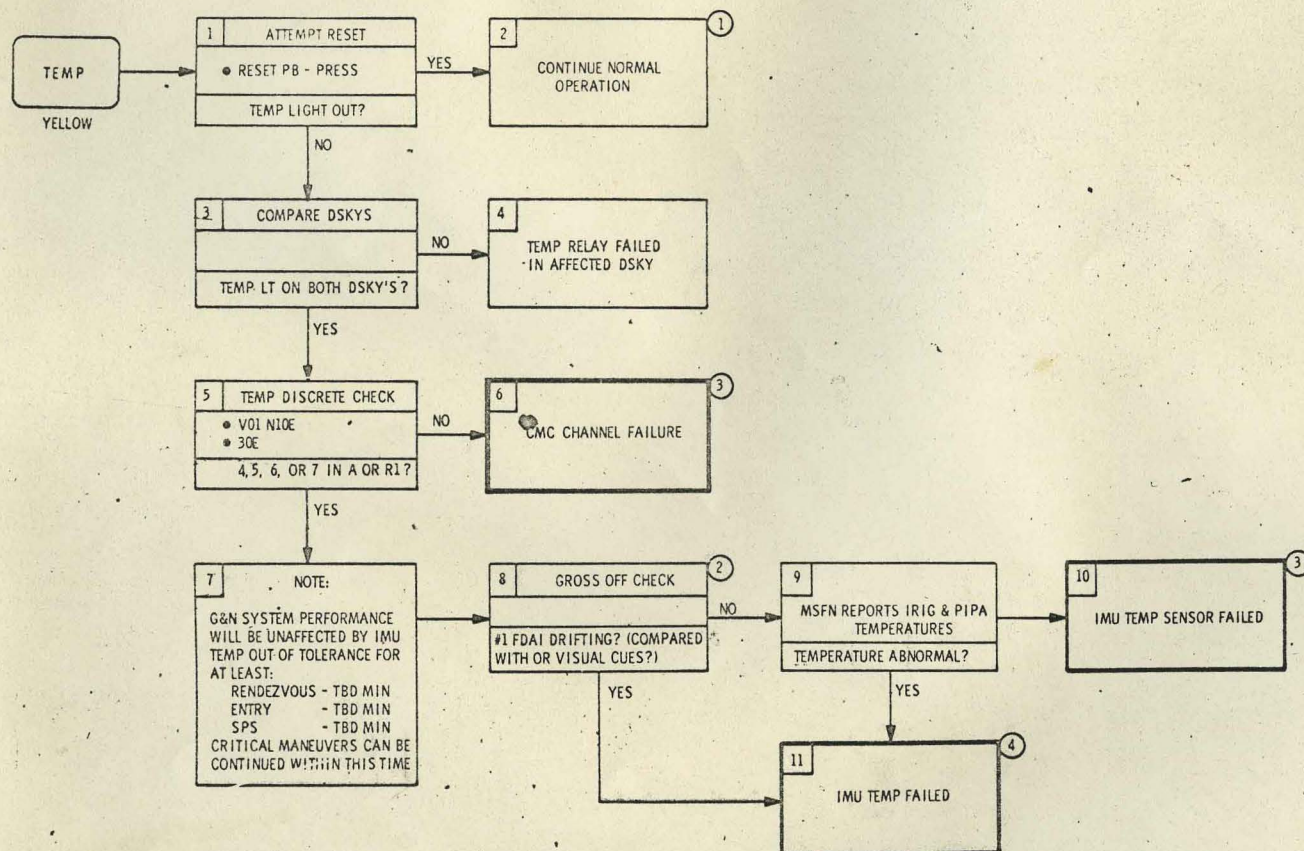
- ① SUBSEQUENT CMC MALFUNCTIONS WILL BE DETECTABLE ONLY BY THE DSKY STATUS LIGHTS OR BY THE LEB LIGHT
- ② ALL CMC FUNCTIONS LOST
- ③ IF DSKY WILL NOT ACCEPT INPUTS, FORCE A RESTART BY SIMULTANEOUSLY PRESSING MARK REJECT AND RESET BUTTONS
- ④ THE TRANSIENT CONDITIONS COULD HAVE EXISTED IN EITHER THE CMC OR C/W SYSTEMS
- ⑤ THESE CONDITIONS CONSIDERED VERY REMOTE
- ⑥ COMPLETE IDENTIFICATION OF SUBSEQUENT FAILURES IMPOSSIBLE. PARTIAL FAILURE IDENTIFICATION CAPABILITY THROUGH THE DSKY STATUS LIGHTS





- ① PIPA FAILURE DURING AVERAGE G WILL CAUSE AN ISS LIGHT WHICH WILL BE EXTINGUISHED ON THE TERMINATION OF AVERAGE G
- ② CMC MONITOR AND CONTROL OF TVC AND ENTRY LOST
- ③ AFFECTS THE ISSUANCE OF AN ISS LIGHT COMMAND
- ④ IMU MAY BE USED AS A TOTAL ATTITUDE REFERENCE ONLY
- ⑤ SUBSEQUENT INDICATIONS OF ISS FAILURE LOST
- ⑥ SUBSEQUENT INDICATIONS OF ISS FAILURES FROM LEB ISS LIGHT





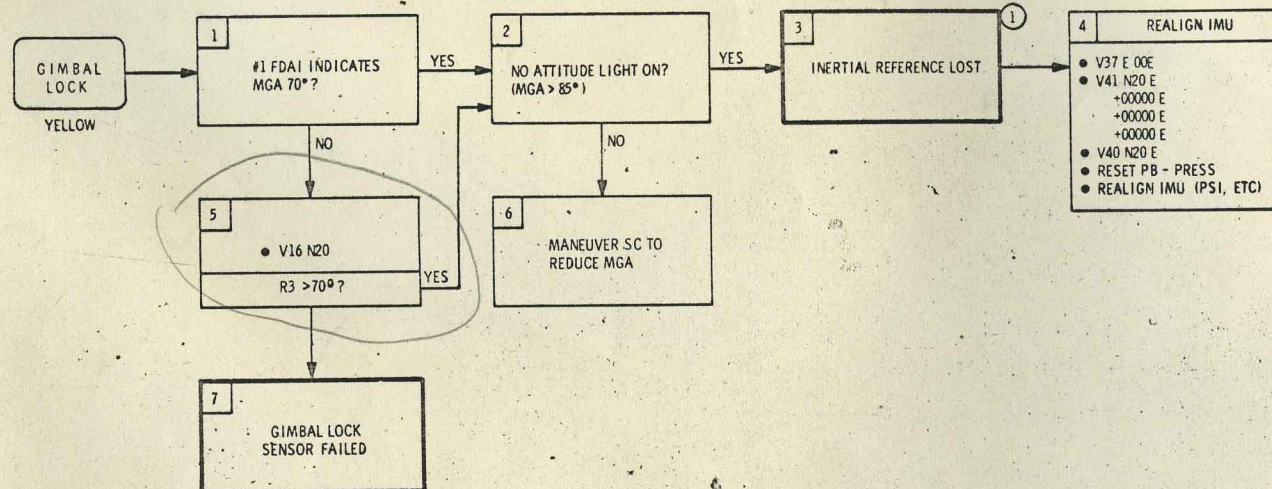
① TRANSIENT ABNORMAL CONDITION

② ASSUMES NORMAL OPERATION OF #1 FDAI HAS BEEN VERIFIED

③ IMU TEMPERATURE AVAILABLE FROM MSFN ONLY

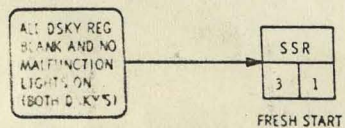
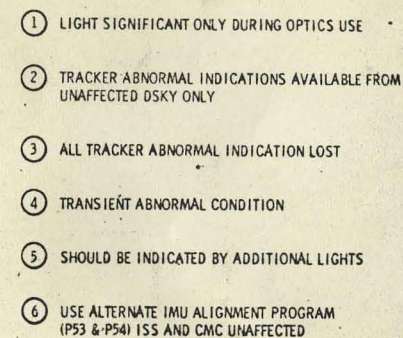
④ IMU UNUSABLE





① IMU IN COARSE ALIGN AND MUST BE REALIGNED TO A NEW INERTIAL REFERENCE

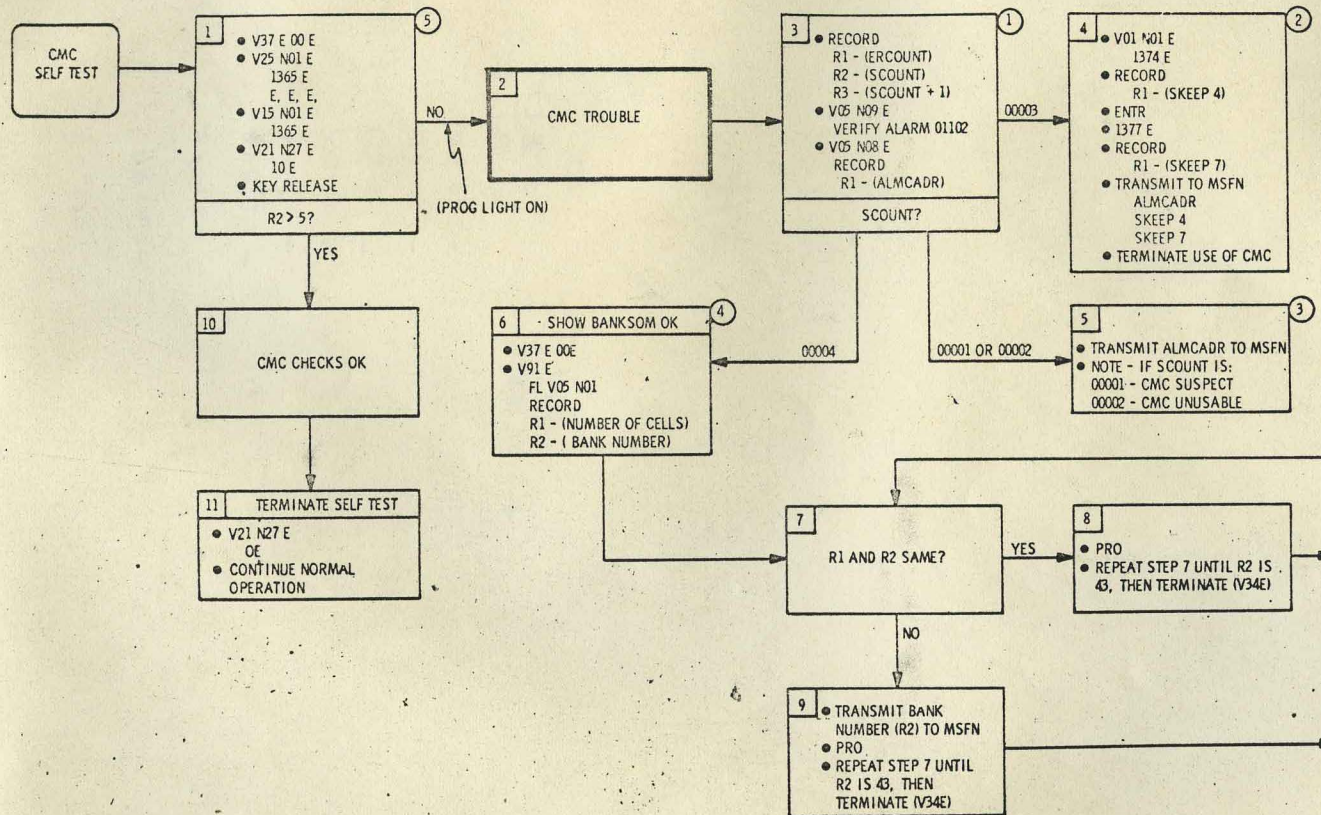












① IF CMC LIGHT IS ON PROCEEDING BEYOND THIS POINT IS A CREW OPTION

② PROBLEM IS IN ERASABLE MEMORY

③ PROBLEM IS CMC CONTROL PROBLEM (00001) OR SPECIAL REGISTER OR CENTRAL PROCESSOR PROBLEM (00002)

④ PROBLEM IS IN FIRED MEMORY

⑤ R2 = 00001 FOR 35-45 MSEC  
R2 = 00002 FOR ~ 20 SEC  
R2 = 00003 FOR ~ 7 SEC  
R2 = 00004 FOR ~ 43 SEC



* 1 light	18.00 -
* 6 poles (37.)	222.00
* 1 201 EC	203.50 -
* 1 200 ES	164.00 -
* 1 204 B	176.00 -
* 1 205	153.00 -
* 1 4812	26.00 -
* 1 3018 P	25.00 -
10 3012	190.00
	<u>1178.50</u>
	$\div 2 = 589.25 \rightarrow$



J. Swigert

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS  
INSTRUMENTATION LABORATORY  
CAMBRIDGE, MASS. 02139

C. S. DRAPER  
DIRECTOR

AG 358-67  
21 September 1967

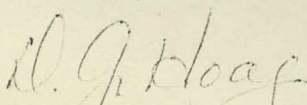
North American Aviation Inc.  
Space and Information Division  
12214 Lakewood Boulevard  
Downey, California

Attention: Mr. J. R. Potts  
Through: NASA/RASPO at MIT/IL  
Subject: GNCS Malfunction Diagrams for SC 101  
Enclosure: DG Memo No. 947

Gentlemen:

The attached DG Memo No. 947 contains preliminary GNCS malfunction diagrams for SC 101. These diagrams fulfill the requirements for AOH Vol. II for SC 101 requested in Part I of MCS TWX EF22-T32-67-392 dated 21 August 1967. Malfunction diagrams for SC 103 are in preparation.

Sincerely,



D. G. Hoag, Director  
Apollo Guidance & Navigation

:hm

cc: W. Schmidt  
L. Larson  
R. Ridnour, NASA/RASPO  
MIT/IL at NAA/S&ID  
MIT/IL at GAEC  
MIT/IL at MSC  
MIT/IL at KSC  
NASA/RASPO at MIT/IL  
J. Lawrence  
NASA/MSC, Houston:  
ASPO-EG(2)  
ASPO-PP6(2)  
ASPO-PP7(2)  
Central Files



MIT Instrumentation Laboratory

DG MEMO NO. 947

TO: R. A. Larson  
FROM: W. W. Schmidt  
DATE: 30 August 1967  
SUBJECT: GNCS Malfunction Procedures

REFERENCES:

1. Telecon from R. Larson to C. Thomas of Manned Spacecraft Center, 8/7/67.
2. MSC TWX EF22-T32-67-392, 8/22/67.

The attached diagrams are a preliminary copy of the GNCS malfunction procedures for SC 101. The procedures are required to support development of the Command and Service Module Apollo Operations Handbook, in accordance with documents referenced above.

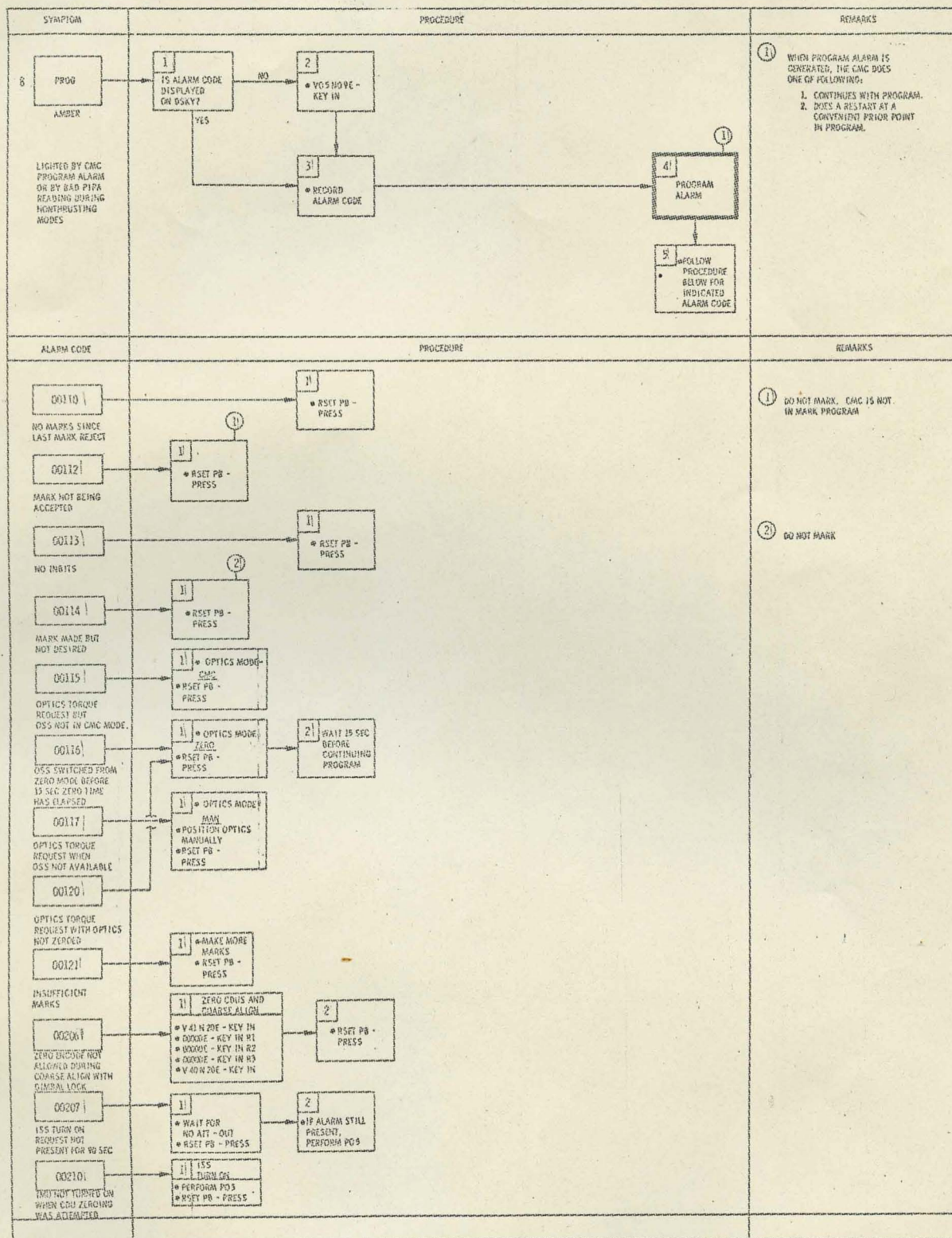


SYMPTOM	PROCEDURE	REMARKS
<p>1</p> <p>CMC</p> <p>RED</p> <p>LIGHTED IN STANDBY AND OPERATE MODES BY: PRIME POWER FAILURE OR SCALER FAILURE</p> <p>LIGHTED FOR 5 SEC IN STANDBY OR OPERATE MODES BY REPEATED (<math>&gt; 0.9</math> PPS) ISSUANCE OF: COUNTER FAILURE OR DOUBLE FREQUENCY SCALER FAILURE</p> <p>LIGHTED FOR 5 SEC ONLY IN OPERATE MODE BY REPEATED (<math>&gt; 0.9</math> PPS) RESTARTS. RESTART IS CAUSED BY: RUPT LOCK, TC TRAP, OSCILLATOR FAIL, PARITY FAIL, NIGHTWATCH MAN, OR VOLTAGE FAIL</p> <p>LIGHT FOR 5 SEC ONLY IN STANDBY MODE BY REPEATED (<math>&gt; 0.9</math> PPS) ISSUANCE OF VOLTAGE FAIL (FAILURE OF +28V, +14V, or +4V POWER SUPPLIES).</p>	<pre> graph TD     1[1] --&gt; 1Q{1 IS S/C UNDER GNCS CONTROL?}     1Q -- YES --&gt; 2[2 SWITCH TO SCS • TC - CW OR • SC CONT - SCS]     1Q -- NO --&gt; 3Q{3 DOES CMC LIGHT REMAIN LIGHTED (&gt;5 SEC) OR RELIGHT REPEATEDLY?}     2 --&gt; 3Q     3Q -- YES --&gt; 6Q{6 IS CMC IN STANDBY MODE?}     3Q -- NO --&gt; 4Q{4 IS PGNS LIGHTED?}     4Q -- YES --&gt; 3Q     4Q -- NO --&gt; 5[5 CMC SELF TEST WHEN TIME PERMITS AND MSFN IS AVAILABLE • V2IN27E • 00010E MSFN REPORTS CMC OK?]     5 -- YES --&gt; 6Q     5 -- NO --&gt; 7[7 TERMINATE PROGRAM • V34E • V37E00E PROGRAM TERMINATED AND POD ENTERED?]     6Q -- YES --&gt; 9Q{9 HAS PRIME POWER TO CMC FAILED?}     6Q -- NO --&gt; 7     7 -- YES --&gt; 8[8 CMC POWER DOWN • V37E00E • ENTR • PRO]     7 -- NO --&gt; 9Q     8 --&gt; 9Q     9Q -- YES --&gt; 11[11 WHEN PRIME POWER IS RESTORED • PERFORM POS • INITIATE DESIRED PROGRAM]     9Q -- NO --&gt; 10[10 CMC FAILURE]     11 --&gt; 12[12 RETURN TO NORMAL OPERATIONS]     </pre>	<p>① CMC NOT FUNCTIONAL</p>
<p>2</p> <p>ISS</p> <p>RED</p> <p>LIGHTED BY: PIPA FAIL DURING THRUSTING IMU FAIL, OR ICDU FAIL</p> <p>PIPA FAIL IF: NO PIPA PULSES FOR 312.2 <math>\mu</math> SEC, BOTH + AND - PULSES, OR A LONG TIME (1.23 TO 3.84 SEC) WITHOUT AT LEAST ONE + AND ONE - PULSE.</p> <p>IMU FAIL IF: ANY GIMBAL SERVO ERROR <math>&gt; 2.9</math> MILLI- RADIAN FOR 2 SEC OR MORE, LOSS OF 3200 CPS PWR, OR LOSS OF GYRO WHEEL PWR.</p> <p>ICDU FAIL IF: FINE ERROR <math>&gt; 1.0</math> VRMS, COARSE ERROR <math>&gt; 2.5</math> VRMS, READ COUNTER LIMIT CYCLE <math>&gt; 100</math> CPS, COS (0 - 6) <math>&lt; 2.0</math> V, OR +14V PWR SUP FAILURE</p>	<pre> graph TD     1[1] --&gt; 1Q{1 IS GIMBAL LOCK LIGHT ON?}     1Q -- YES --&gt; 5[5]     1Q -- NO --&gt; 2Q{2 IS S/C UNDER GNCS CONTROL?}     2Q -- YES --&gt; 3[3 SWITCH TO SCS • TC - CW OR • SC CONT - SCS]     2Q -- NO --&gt; 4[4 ISS POWER DOWN • V37E00E • GIN POWER, IMU - OFF • ENTR • PRO]     3 --&gt; 4     4 --&gt; 5[5 ISS FAILURE]     </pre>	<p>① IMU NOT FUNCTIONAL</p>



SYMPTOM	PROCEDURE	REMARKS
<p>3</p> <p>POWS</p> <p>AMBER</p> <p>LIGHTED BY ANY OF FOLLOWING: PROGRAM ALARM, IMU TEMP FAIL, GIMBAL LOCK, TRACKER FAIL, OR RESTART</p>	<p>1   NOTE: IF CMC OR TSS IS ALSO LIGHTED USE APPROPRIATE PRECEDING PROCEDURE.</p> <p>2   MONITOR DSKY IS TEMP LIGHT ON?</p> <p>3   IS GIMBAL LOCK LIGHT ON?</p> <p>4   IS PROG LIGHT ON?</p> <p>5   IS RESTART LIGHT ON?</p> <p>6   IS TRACKER LIGHT ON?</p> <p>7   CCM FAILURE</p> <p>8  </p>	
<p>4</p> <p>TEMP</p> <p>AMBER</p> <p>LIGHTS WHEN IMU TEMPERATURE IS OUT OF LIMITS, &lt; 126 OR &gt; 134°F</p>	<p>1   DSKY RSET RP - PRESS TEMP LIGHT OUT?</p> <p>2   SWITCH TO SCS TC - ON OR SC CONT - SCS</p> <p>3   IMU TEMP FAILURE</p> <p>4   CONTINUE NORMAL OPERATION</p>	<p>1   IMU TEMPERATURE IS OUTSIDE OF DESIGN LIMITS. HAVE MSPN MONITOR TSS PARAMETERS TO DETERMINE IF IMU IS USABLE.</p> <p>2   TRANSIENT ABNORMAL CONDITION</p>
<p>5</p> <p>GIMBAL LOCK</p> <p>AMBER</p> <p>LIGHTS WHEN MGA &gt; 76°</p>	<p>1   IS NO ATT LIGHT ON?</p> <p>2   MANEUVER SC TO AVOID GIMBAL LOCK, OR REALIGN IMU (PSI) RSET RP - PRESS</p> <p>3   IMU HAS ENTERED GIMBAL LOCK</p> <p>4   WAIT FOR NO ATT - OUT PERFORM PSI RSET RP - PRESS</p>	<p>1   GIMBAL LOCK IS IMMINENT, CAN BE AVOIDED BY MANEUVERING SC.</p> <p>2   GIMBAL LOCK HAS TAKEN PLACE. IMU MUST BE REALIGNED.</p>
<p>6</p> <p>RESTART</p> <p>AMBER</p> <p>LIGHTED BY ANY OF FOLLOWING: PARITY FAIL, RUP LOCK, TC TRAP, NIGHT WATCHMAN OR VOLTAGE FAIL</p>	<p>1   RSET PB - PRESS RESTART OUT?</p> <p>2   SWITCH TO SCS TC - ON OR SC CONT - SCS</p> <p>3   CMC SELF CHECK REQUEST MSPN TO MONITOR AND EVALUATE CMC PERFORMANCE V21 REZE - KEY IN OXIDE - KEY IN R3</p> <p>4   CONTINUE NORMAL OPERATION</p>	<p>1   CMC MAY BE UNRELIABLE. IMU MAY BE USED AS A BACKUP ATTITUDE REFERENCE.</p> <p>2   TRANSIENT ABNORMAL CONDITION</p>
<p>7</p> <p>TRACKER</p> <p>AMBER</p> <p>LIGHTED BY OPTICS CDU FAILURE.</p>	<p>1   RSET PB - PRESS TRACKER OUT?</p> <p>2   MANUAL OPTICS CONTROL OPTICS MODE - MAN DRIVE OPTICS WITH HAND CONTROL RSET PB - PRESS TRACKER OUT?</p> <p>3   OPTICS SHUTDOWN ON POWER, OPTICS - OFF</p> <p>4   OPTICS CDU FAILURE</p> <p>5   CONTINUE NORMAL OPERATION</p>	<p>1   TCDU'S DRIVING TOO FAST</p> <p>2   OPTICS UNRELIABLE. SGT MAY BE STILL BE USED MANUALLY. TSS AND CMC ARE STILL OPERATIVE.</p> <p>3   TRANSIENT ABNORMAL CONDITION</p>
SYMPTOM	PROCEDURE	REMARKS







ALARM CODE	PROCEDURE	REMARKS
00211 COARSE ALIGN ERROR > 3°	1 • RSET PB-PRESS	1 OPERATOR HAS OPTION OF CONTINUING WITH IMU FINE ALIGNMENT, REATTEMPTING COARSE ALIGNMENT, OR TERMINATING USE OF IMU. THE AMOUNT OF MISALIGNMENT IS INDICATED ON THE DSKY DURING GYRO TORQUING ROUTINE.
00212 PIPA FAIL WHEN PIPA'S NOT IN USE	1 • RSET PB-PRESS	2
00213 IMU NOT OPERATING WITH TURN ON REQUEST	1 • TERMINATE PROGRAM RSET PB-PRESS	2 ISS TURN ON • PERFORM POS • REINITIATE TERMINATED PROGRAM
00214 PROGRAM USING IMU WHEN IMU OFF	1 • EITHER V32E • SELECT NOMINAL OR REFSAMAT OPTION OR • V32E • SELECT PROGRAM TO DEFINE PREFERRED ORIENTATION	2 • RSET PB-PRESS
00215 PREPARED IMU ORIENTATION SELECTED BUT NOT SPECIFIED	1 • RSET PB-PRESS	2
00216 BAD PIPA READING	1 • RSET PB-PRESS	2
00401 DESIRED GIMBAL ANGLES YIELD GIMBAL LOCK	1 • EITHER • MANEUVER SC TO ACQUIRE TARGET • PRO PB-PRESS • RSET PB-PRESS OR • SELECT NEW TARGET • V32E • RSET PB-PRESS OR • V32E • RSET PB-PRESS	2 • RSET PB-PRESS
00404 TARGET BEYOND TRUNNION LIMITS	1 • EITHER • MANEUVER SC TO ACQUIRE TWO STARS • PRO PB-PRESS OR • MANEUVER SC SO TWO STARS MAY BE AUTOMATICALLY ACQUIRED • V32E	2 • RSET PB-PRESS
00405 TWO USEABLE STARS NOT AVAILABLE	1 • KEY REL PB-PRESS • RSET PB-PRESS	3 NOT POSSIBLE TO PERFORM R22
00406 POD NOT IN PRO- CESS WHEN R22 REQUESTED	1 • V32E • ADJUST INPUT PARAMETERS • RSET PB-PRESS	
00607 SPECIFIED GT GIVES HYPERBOLIC VELOCITY	1 • V32E • RELOAD E • RSET PB-PRESS	
00611 NO TIG FOR GIVEN E	1 • RSET PB-PRESS • INFORM MSFN OF ALARM	
01105 DOWNLINK TOO FAST	1 • RSET PB-PRESS REQUEST MSFN TO RETRANSMIT UPLINK DATA	
001106 UPLINK TOO FAST	1 • RSET PB-PRESS	
01426 VVR NOT WITHIN 30° OF +Y <sub>SM</sub>	1 • RSET PB-PRESS	4 FDM ATTITUDE DISPLAY FROM IMU INVERTED, E.I. OF ROLL IS LEFT DOWN
01427 VVR WITHIN 30° OF +Y <sub>SM</sub>	1 • RSET PB-PRESS	
01703 GETI LESS THAN 45 SECONDS	1 • SLIP GETI TO 45 SECONDS FROM TIME PRO PB IS PRESSED • PRO PB-PRESS • RSET PB-PRESS	