

UNCLASSIFIED

AD 274 292

*Reproduced
by the*

**ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA**



UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.



VOLUME III

HUMAN FACTORS ENGINEERING REVIEW AND EVALUATION

WEAPON SYSTEM 107A-2 LAUNCHER, OSTF AND TF-1

FINAL REPORT

CONTRACT NUMBER AF 04 (647) - 138



HUMAN FACTORS ENGINEERING

TECHNICAL STAFF



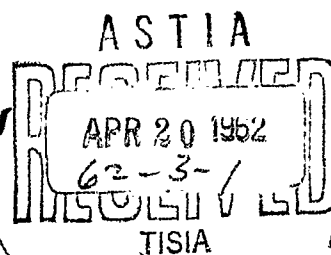
AMERICAN MACHINE & FOUNDRY COMPANY

GREENWICH ENGINEERING DIVISION

GREENWICH, CONN.



CATALOGED BY ASTIA
AS AD NO. 274292





VOLUME III

HUMAN FACTORS ENGINEERING REVIEW AND EVALUATION

WEAPON SYSTEM 107A-2 LAUNCHER, OSTF AND TF-1

FINAL REPORT



CONTRACT NUMBER AF 04 (647) - 138



HUMAN FACTORS ENGINEERING

TECHNICAL STAFF



AMERICAN MACHINE & FOUNDRY COMPANY

GREENWICH ENGINEERING DIVISION

GREENWICH, CONN.



TS 7.2.36
In 3 Volumes

HUMAN FACTORS ENGINEERING
REVIEW AND EVALUATION OF TITAN WEAPON
SYSTEM 107A-2 LAUNCHER, OSTF & TF-1
FINAL REPORT
Contract No. AF 04(647)-138

The Human Factors Engineering Group
Technical Staff

31 January 1962
Volume III
Appendix

AMERICAN MACHINE & FOUNDRY COMPANY
GREENWICH ENGINEERING DIVISION
GREENWICH, CONNECTICUT

Appendix A

Mobile Test Rack-Human Factors
Review - OSTF

AMERICAN MACHINE & FOUNDRY COMPANY
ENGINEERING DIVISION

☐ FIELD TRIP REPORT
☐ MEETING REPORT
☒ ENGINEERING REPORT

July 22, 1959

ER-TPS-221

DATE

SERIAL NO.

J. O. #213-4-57

PROJECT OR JOB NO.

PAGE

OF

PERIOD COVERED

WRITTEN BY

TO: _____

CUSTOMER: _____

SUBJ.: MOBILE TEST RACK-HUMAN FACTORS

ADDRESS: _____

REVIEW - OSTF

PERSON CONTACTED: _____

1.0 PURPOSE:

To evaluate existing plans for the WS 107A-2 Mobile Test Rack with respect to established principles and practices of human engineering in order to maximize the effectiveness of the weapon system through minimization of human errors in operation.

2.0 SUMMARY: 2.1

Modifications - The OSTF Mobile Test Rack has been modified for inclusion in OB - TB designs based upon an analysis by the Human Factors Group in cooperation with the Electro-Mechanical Lab., Stamford. This redesign is the result of scope change calling for a stationary design consolidation of the Test Equipment, Logic Equipment and Fault Readout Equipment per TD #59-4016.

2.1.1 The entire unit has been made stationary by relocating the components into equipment racks in the Electrical Room of the Equipment Terminal Silo.

2.1.2 The Operating Panel has been located as shown in Figure I.

2.1.3 The Operating Panel has been re-designed and will be completely described in ER-TPS-222, Mobile Test Rack Human Factors Review OB-TB.

2.1.4 Connection into circuits has been accomplished by plugging in four, 100 pin connectors found hinged to the Connector Panel. See Figure II.

2.1.5 The lamp test has been revised to include the lamps in the Connector Panel.

2.2 Evaluation (OSTF)

- 2.2.1 The required weight and dimensions of the Mobile Test Rack, considered from the handling standpoint, are very likely to restrict the movement of this unit from one Equipment Terminal Silo to another. There are ramps, tunnel grades and turns which must be negotiated in all areas.
- 2.2.2 Description of color codes should be lettered on panel front over each display to reduce chance of error. The colors indicated by the various displays are correctly used according to specification but they have different connotations on different displays (i. e., GREEN means "GO" in the Launcher Status display and (TEST) "COMPLETED" in the Test Status display).
- 2.2.3 The exercising of actual hardware should be restricted by the use of a key switch and a separate panel display should be used to indicate whether the test is simulated-or with the actual launcher in motion.
- 2.2.4 The Launcher Shutdown pushbutton display should read "SHUTDOWN" to better describe
REVERSE
the action which takes place when this display indicates WHITE.
- 2.2.5 The "Extended Umbilicals" test should be included as part of each regular test sequence in which the umbilicals would normally be retracted (involving Launcher movement).

2.2.6 The displays in the Connector Panel have a NO LIGHT condition which indicates that plugging in is not allowed. This condition may be confused with a dead lamp situation and there is no lamp test for these displays. Displays should be redesigned to read RED for no plugging and GREEN for plugging allowed and these lamps should be included in the lamp test.

2.2.7 Connector Panel displays should indicate the correct sequence for unplugging by the use of RED and GREEN lights.

3.0 REFERENCES: 3.1 The following AMF drawings were used in the preparation of this report:

59-204-1171 Panel Assembly -
Operating Test

59-204-1150 Rack Assembly -
Test Mobile

3.2 The following AMF specification was used as a partial basis for the analysis section of this report:

Operation Test Controller and Test
Responder - Sub-System Test Specifi-
cation and TEA Operating Procedure.

3.3 Information regarding the operation of this equipment was gathered by the writer in conjunction with L. J. Seiden of the Stamford Laboratory.

4.0 BASIC ASSUMPTIONS - HUMAN FACTORS EVALUATIONS

4.1 All human factors requirements described within Detail Model Specifications, Technical Directives, and documents referenced therein are AMF contractual obligations.

4.2 The Human Factors Group is obligated to point out exact violations of the above and to make further recommendations which would improve man-machine compatibility. These recommendations may lead to changes which extend beyond AMF contractual obligations and should be included only where time and cost factors will permit.

FUNCTION CHASSIS	INTER- CONNECTION CABINET	CIRCUIT BREAKER CHASSIS	TIMER CHASSIS
FUNCTION CHASSIS		CONTACTOR CHASSIS	OPERATING PANEL
FUNCTION CHASSIS		COMBINATION CHASSIS	FAULT REGISTER
FUNCTION CHASSIS		TEST PROGRAM	COMBINATION CHASSIS
FUNCTION CHASSIS		FAULT LOCATOR	COMBINATION CHASSIS
FUNCTION CHASSIS AUTOMATIC PROGRAMMING		DIODE CHASSIS	COUNTER CHASSIS
FUNCTION CHASSIS AUTOMATIC PROGRAMMING		TEST RELAYS	CONNECTOR PANEL

FIGURE I FRAME LAYOUT - COMBINED UNITS

TABLE I

MAN-MACHINE ANALYSIS OF THE PORTABLE TEST RACK

The following is a man-machine analysis of the OSTF Mobile Test Rack in its various testing functions. The table is divided into three vertical columns. The first column is an index of separate items or steps in the procedure; the second describes the operator's inputs as he performs each test; and the third briefly outlines the machine's response to controls as the machine and the operator complete each step in the sequence. This analysis has been written with several purposes in mind. It has helped to acquaint the writer with the equipment so that an evaluation of human factors considerations could be made and improvements to the design could follow. This analysis describes the tests which can be performed with the equipment along with the requirements and limitations involved. This analysis can also be used in the field if changes have to be evaluated resulting from the Operational Systems Human Factors Test.

ITEM	MAN (OPERATOR)	MACHINE
1.0	<u>CONNECTION OF PORTABLE TEST RACK</u>	
1.1	COMMAND	Receive command to make a test from proper authority.
1.2	CONNECTOR PANEL	
1.2.1	FIRST TEST RESPONDER	 Observe status of lights above connectors on panel. Plug in first Test Responder cable if light is <u>GREEN</u> over corresponding connector.  A <u>NO LIGHT</u> condition in any display on the Connector Panel also indicates that the corresponding plug must not be inserted  Displays (lights) indicate: <u>GREEN</u> = go <u>RED</u> = no go above each connector on Connector Panel. A <u>RED</u> light in all four displays indicates that the logic circuitry is not available for a test either because of a fault or test already in process. A <u>GREEN</u> light displayed over the first connector (on the left) indicates that the logic circuitry is available for test and that the first Test Responder cable may be connected.
1.2.1.1	BUS SWITCHING	 Connection of the first Test Responder cable removes voltage from the interlock bus and switches the voltage on the Solenoid bus from 26 volts to 3 volts.

ITEM	MAN (OPERATOR)	MACHINE
1.2.1.2	CONNECTOR DISPLAY <u>RED</u>	Successful completion of the above changes the light above the second Test Responder connector from <u>NO LIGHT</u> to <u>GREEN</u> .
1.2.2	SECOND TEST RESPONDER	Observe status of light above second Test Responder connector. Plug in corresponding cable if light is <u>GREEN</u>. △ This completes connection of the 3 volt relays to the Solenoid Bus. △ The display over the Test Controller connector will indicate <u>GREEN</u> when insertion of the corresponding plug is allowed. △ This removes the voltage from the Launch Controller Signal bus - changes the signals traveling from the AMF Launcher Controller to the Launch Controller from 26 volts to 3 volts - and connects the Test Controller parallel to the latter. △
1.2.3	FIRST TEST CONTROLLER	If light is <u>RED</u> follow trouble-shooting procedure. △ Observe status of light above the first Test Controller connector. Plug in corresponding cable if light is <u>GREEN</u>. △

ITEM	MAN (OPERATOR)	MACHINE
2.0	<u>PREPARE FOR TEST</u>	
2.1	LAMP TESTS	
2.1.1	<u>RED LAMP TEST</u>	Test lamps in displays as follows: Push Lamp Test button designated as <u>RED</u>.  Voltage to all lamps other than <u>RED</u> will be temporarily cut off. <u>All RED</u> lamps should light.  Check manual for displays requiring <u>RED</u> lights. Replace all lamps which fail to light and repeat <u>RED</u> lamp test.
2.1.2	<u>WHITE LAMP TEST</u>	Push lamp test button designated as  Voltage to all lamps other than <u>WHITE</u> will be temporarily cut off. <u>All WHITE</u> lamps should light.  Check manual for displays requiring <u>WHITE</u> lights. Replace all lamps which fail to light and repeat <u>WHITE</u> lamp test.
2.1.3	<u>GREEN LAMP TEST</u>	Push lamp test button designated as  Voltage to all lamps other than <u>GREEN</u> will be temporarily cut off. <u>All GREEN</u> lamps should light.  Check manual for displays requiring <u>GREEN</u> lights. Replace all lamps which fail to light and repeat <u>GREEN</u> lamp test.

ITEM	MAN (OPERATOR)	MACHINE
2.2	TEST RACK PANEL	△ Observe the Test Rack Operating Panel displays. After all cables have been successfully connected the Operating Panel should display the following:
2.2.1	LAUNCHER STATUS	△ Observe color of Launcher Status display with Test Selector in the "OFF" position. Launcher Status - <u>GREEN</u> - indicates that the simulated launcher is in a "GO" or operational status.
2.2.1.1	LAUNCHER STATUS <u>RED</u>	△ Launcher Status - <u>RED</u> - indicated that the simulated launcher is in a "NO GO" or non-operational status. △ In order to proceed with any test the Launcher Status display must be <u>GREEN</u>.
2.2.1.2	LAUNCHER STATUS <u>RED</u> <u>RESET FOR SIMULATED</u> <u>TEST</u>	△ To proceed with a <u>simulated test</u> (no actual hardware movement) push the Launcher Status button. Function relays will correlate with respect to a test "GO" status. A <u>GREEN</u> light will then appear in the Launcher Status display indicating that the Function relays are latched in the "GO" condition while the actual Launcher may remain inoperative.

ITEM	MAN (OPERATOR)	MACHINE
2.2.2	TEST STATUS <u>GREEN</u> Observe color of Test Status Display.	 Test Status - <u>GREEN</u> - indicates that the test equipment is operational or (ready for test).
2.2.2.1	TEST STATUS <u>NO LIGHT</u> Push Launcher Status push-button.	 <u>NO LIGHT</u> indicates that stepping relay is not at normal starting position if <u>GREEN</u> lamp test is positive. (See Lamp Test above.)
		 Stepping relay will be returned to normal starting position.
		Test Status - <u>GREEN</u> - will indicate operational condition.

ITEM	MAN (OPERATOR)	MACHINE
3.0	<u>TEST NORMAL FIRING CYCLE (SIMULATED)</u> Position Test Selector Switch to "Sequence Test." Position Sequence Selector Switch to "After Normal Fire". Press "Start" pushbutton	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress. The Test Responder receives Function Relay signals which would be received in actual firing cycle by the Launcher solenoids. The Test Controller sends to the Function Relays signals which would be sent in an actual firing cycle by the Launcher limit switches and interlocks. In this manner the Function Relays are exercised through all of the steps required to initiate and complete the normal firing cycle, cool the Launcher equipment, and return to "Shut-down", stopping only upon successful completion of test (in this event Test Status display indicates <u>GREEN</u>); or in case of failure which <u>immediately</u> stops the test and causes the Test Status display to indicate <u>RED</u>. Launcher Status <u>RED</u> in combination with a Test Status <u>GREEN</u> indicates a successful, but incomplete test.
3.1	START TEST	
3.2	TEST IN PROGRESS	The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after TOWER TILTED signal has been simulated.
3.3	<u>TEST STATUS GREEN</u>	In test status <u>GREEN</u> observe that the Launcher Status <u>indicates RED</u>.

ITEM	MAN (OPERATOR)	MACHINE
3.3.1	RESTORE TO PRETEST CONDITIONS	 Restore test system to pretest CONDITIONS in either of the following ways: 3.3.1.1 EXTEND UMBILICALS TEST 1. Complete the last phase of the test by pushing the Extended Umbilical button.  OR 3.3.1.2 FUNCTION RELAY CORRELATION 2. Push the Launcher Status button.  Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u> .  After the Test Status display indicates that a fault has occurred the Launcher Status display will indicate that the Fault Punch has completed punching out the fault by switching to <u>RED</u> .  If the test has successfully stepped to the command position set on the Sequence Selector and is returning to shutdown when a fault occurs the Launcher Shutdown display will indicate <u>WHITE</u> .
3.4	TEST STATUS <u>RED</u>	Observe Test Status display.
3.5	LAUNCHER STATUS <u>RED</u>	Observe Launch Status display. If the Test Status and the Launcher Status displays both show <u>RED</u> proceed as follows:

ITEM	MAN (OPERATOR)	MACHINE
3.5.1	LAUNCHER SHUTDOWN <u>WHITE</u>	
3.5.1.1	FAULT PUNCH TAPE	If the Launcher Shutdown display indicates <u>WHITE</u> observe the punch code on the fault punch tape and proceed to troubleshoot according to the procedure outlined in the troubleshooting manual.
3.5.1.2	TROUBLESHOOT AND RETEST	When fault has been corrected following troubleshooting procedure repeat entire test as outlined above.
3.5.2	LAUNCHER SHUTDOWN <u>"NO LIGHT"</u>	 Launcher Shutdown indicates <u>NO LIGHT</u> .
3.5.2.1	RETURN TO SHUTDOWN	 Depressing the Launcher Shutdown Pushbutton simulates action that would normally (actual hardware movement as controlled by others) take place at the launch controller in case of fault. When this pushbutton is depressed it will display <u>WHITE</u> light and the Test Status display should turn from <u>RED</u> to <u>WHITE</u> indicating that the test is in progress again in the return sequence.
3.5.2.2	TEST STATUS <u>RED</u>	 Should another fault occur during this sequence the test status display will indicate <u>RED</u> .

ITEM	MAN (OPERATOR)	MACHINE
3.5 2.3	FAULT PUNCH TAPE	Observe fault punch tape as before for the punched out fault. Upon completion of punching out the fault the Launcher Status display will again indicate <u>RED</u>.
3.5 2.4	FUNCTION RELAY CORRELATION	Push the Launcher Status Button. Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u>.
3.5.2.5	TROUBLESHOOT AND RETEST	Troubleshoot according to the procedure outlined in the Trouble-Shooting Manual and repeat entire test as outlined above.
3.6	END OF TEST	Operator must disconnect <u>all</u> cables from Connector Panel at the completion of any testing program.
3.7	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller, First Test Responder and Second Test Responder. Connector panel displays will indicate <u>GREEN</u> at end of test cycle. Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
4.0	TEST SHUTDOWN COMMAND AFTER HYDRAULIC POWER PACK ON COMMAND Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector Switch to "SEQUENCE TEST". Position Sequence Selector Switch to "HYDRAULIC POWER PACK ON".	
4.1	START TEST	 Test Status display turns from GREEN to <u>WHITE</u> indicating test in progress.
4.2	TEST IN PROGRESS	The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after HYDRAULIC POWER PACK operating signal has been simulated. The Test Responder receives Function Relay signals which would be received in actual operation (while Hydraulic Power Pack is being put on) by the Power Pack solenoids. The Test Controller sends to the Function Relays, signals which would be sent in actual cycle of operation by the Power Pack limit switches and interlocks. In this manner the Function Relays are exercised through all of the steps required to initiate and complete activation of the Hydraulic Power Pack and return to "Shutdown" stopping only upon successful completion of test. (In this event Test Status display indicates <u>GREEN</u>; or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.)

ITEM	MAN (OPERATOR)	MACHINE
4.3	TEST STATUS <u>GREEN</u>	Observe color of Test Status display; if <u>GREEN</u> test is completed successfully. Observe color of Launcher Status display. Launcher Status display will indicate <u>GREEN</u> upon completion of test.
4.4	TEST STATUS <u>RED</u> LAUNCHER STATUS <u>RED</u>	If Test Status and Launcher Status display indicates <u>RED</u> follow procedure in items 3.5.1 through 3.5.2.5. When a fault occurs during a test, the Test Status display indicates <u>RED</u>.
4.5	END OF TEST	Operator must disconnect all cables from connector panel at the completion of any testing program.
4.6	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder. Connector Panel displays will indicate <u>GREEN</u> at end of test cycle. Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
5.0	<u>TEST SHUTDOWN</u> <u>COMMAND DURING</u> <u>CRIB LOCKING</u> Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector to "SEQUENCE TEST". Position Sequence Selector to "LOCKING CRIB".	
5.1	START TEST	Press "START" pushbutton. △ Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
5.2	TEST IN PROGRESS	The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after HYDRAULIC POWER PACK on signal has been simulated. Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point during CRIB LOCKING and back to SHUTDOWN. The sequence will continue until successful completion of the test (in this event, Test Status display indicates <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>. △
5.3	ANALYSIS OF INDICATOR LIGHT COLORS	Follow items 4.3 through 4.4 above.
5.4	END OF TEST	Operator must disconnect all cables from connector panel at the completion of testing program. △ Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
6.0	<u>TEST SHUTDOWN</u> <u>COMMAND DURING</u> <u>REMOVAL OF CABLE</u> <u>SLACK</u> Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector to "SEQUENCE TEST". Position Sequence Selector to "REMOVING CABLE SLACK".	
6.1	START TEST Press "START" pushbutton.	△ Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in <u>progress</u>. Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point during REMOVAL OF CABLE SLACK and back to Shutdown. The sequence will continue until successful completion of the test (in this event, Test Status display indicates <u>GREEN</u>) ; or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.
6.2	TEST IN PROGRESS The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after CRIB LOCKED signal has been simulated.	
6.3	ANALYSIS OF INDICATOR LIGHT COLORS Follow items 4.3 through 4.4 above.	▽

ITEM	MAN (OPERATOR)	MACHINE
6.4	END OF TEST	Operator must disconnect all cables from Connector Panel at the completion of any testing program.
6.5	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.  Connector panel displays will indicate GREEN at end of test cycle.  Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
7.0 <u>TEST SHUTDOWN COMMAND</u> <u>AFTER CABLE SLACK</u> <u>REMOVED</u>	Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector to "SEQUENCE TEST". Position Sequence Selector to "Removing Cable Slack". Press "START" pushbutton.	Test Status display turns from GREEN to <u>WHITE</u> indicating test in progress. Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point directly after REMOVAL OF CABLE SLACK and back to SHUTDOWN. The sequence will continue until successful completion of the test (in this event, Test Status display indicates <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.
7.1 START TEST		
7.2 TEST IN PROGRESS	The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after CABLE SLACK REMOVED signal has been simulated.	Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point directly after REMOVAL OF CABLE SLACK and back to SHUTDOWN. The sequence will continue until successful completion of the test (in this event, Test Status display indicates <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.
7.3 ANALYSIS OF INDICATOR LIGHT COLORS	Follow items 4.3 through 4.4 above.	

ITEM	MAN (OPERATOR)	MACHINE
7.4 END OF TEST	Operator must disconnect all cables from connector panel at the completion of testing program.	
7.5 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.	
		Connector Panel displays will indicate <u>GREEN</u> at end of test cycle.
		Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
8.0	<u>TEST SHUTDOWN COMMAND DURING LAUNCHER PLAT- FORM IN MOTION</u> Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector to "Sequence Test". Position Sequence Selector to "Platform in Motion". Press "START" pushbutton.	Test Status display turns from GREEN to <u>WHITE</u> indicating test in progress. Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point during LAUNCHER PLAT- FORM MOTION and back to SHUT- DOWN. The sequence will continue until successful completion of the test (in this event, the Test Status display will indicate <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.
8.1	START TEST	
8.2	TEST IN PROGRESS	The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after the RAISE PLATFORM signal has been simulated; and in the special ACTUAL HARDWARE MOTION TEST (See item following) checks the capability of the Launcher Platform to reverse while in motion. Follow items 3.3 through 3.5.2.5 above. Operator must disconnect all cables from connector panel at the completion of testing program,
8.3	ANALYSIS OF INDICATOR LIGHT COLORS	
8.4	END OF TEST	

ITEM	MAN (OPERATOR)	MACHINE
8.5 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.	Connector panel displays will indicate <u>GREEN</u> at end of test cycle. Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM

MAN (OPERATOR)

MACHINE

9.0 TEST SHUTDOWN COMMAND
AFTER LAUNCHER PLAT-
FORM UP & LOCKED

Check for compliance with items
1.0 through 2.2.2.1 above.

Position Test Selector to
"SEQUENCE TEST".

Position Sequence Selector to
"PLATFORM UP & LOCKED".

9.1 START TEST

Press "START" pushbutton.

△ Test Status display turns from
GREEN to WHITE indicating
test in progress.

9.2 TEST IN PROGRESS

The purpose of this test is to
determine whether or not the
SHUTDOWN command signal
can be received by the Function
Relays immediately after the
LAUNCHER PLATFORM UP
AND LOCKED signal has been
simulated.

Function Relays are exercised in
all of the steps of the sequence
normally followed from SHUTDOWN
to the point where the LAUNCHER
PLATFORM is UP AND LOCKED
and back to SHUTDOWN. The
sequence will continue until suc-
cessful completion of the test
(in this event, the Test Status
display indicates GREEN); or in
case of failure which immediately
stops the test and causes the Test
Status display to indicate RED.

9.3 ANALYSIS OF INDICATOR
LIGHT COLORS

Follow items 3.3 through
3.3.2.5 above.

9.4 END OF TEST

Operator must disconnect all cables
from connector panel at the completion
of testing program.

ITEM	MAN (OPERATOR)	MACHINE
9.5 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.	Connector Panel displays will indicate <u>GREEN</u> at end of test cycle. Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
10.0	<u>TEST SHUTDOWN COMMAND</u> <u>AFTER READY TO FIRE</u> Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector to "Sequence Test". Position Sequence Selector to "AFTER READY TO FIRE". Press "START" pushbutton.	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress. Function Relays are exercised in all of the steps of the sequence normally followed from SHUT-DOWN to the point where the signal (READY TO FIRE) is given and back to SHUTDOWN). The sequence will continue until successful completion of the test (in this event, the Test Status display indicates <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.
10.1	START TEST	
10.2	TEST IN PROGRESS	
10.3	ANALYSIS OF INDICATOR LIGHT COLORS	
10.4	END OF TEST	

ITEM	MAN (OPERATOR)	MACHINE
10.5 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.	 Connector Panel displays will indicate <u>GREEN</u> at end of test cycle.  Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
11.0	<u>TEST SHUTDOWN COMMAND</u> <u>AFTER FIRE SWITCH I</u> Check for compliance with items 1.0 through 2.2.2.1 above. Position Test Selector to "SEQUENCE TEST". Position Sequence Selector to "AFTER FIRE SWITCH I".	
11.1	START TEST Press "START" pushbutton.	△ Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress. Function Relays are exercised in all of the steps of the sequence normally followed from SHUTDOWN to the point AFTER FIRE SWITCH I where a signal to cool the launcher equipment is simulated and the system returns to SHUTDOWN. The sequence will continue until successful completion of the test (in this event, the Test Station display indicates <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Station display to indicate <u>RED</u>. ▽
11.2	TEST IN PROGRESS The purpose of this test is to determine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after the FIRE SEQUENCE COMPLETE signal has been simulated.	
11.3	ANALYSIS OF INDICATOR LIGHT COLORS Follow items 3.3 through 3.3.2.5 above.	
11.4	END OF TEST Operator must disconnect all cables from connector panel at the completion of testing program.	

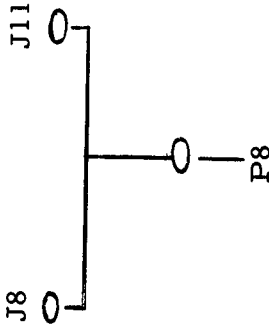
ITEM	MAN (OPERATOR)	MACHINE
11.5 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.	Connector Panel displays will indicate <u>GREEN</u> at end of test cycle. Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
12.0	<u>TEST FAULT DETECTION, FAULT LOCATION AND REGISTRATION CIRCUITRY</u> Check for compliance with items 1. 0 through 2.2.2. 1 above. Position Test Selector to "Fault Test". Position Sequence Selector to "AFTER NORMAL FIRE". Position Timer Selector to Position I. Press "START" pushbutton.	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress. Fault signals are simulated which will cause every fault to be registered on the punched tape along with periodic fault check punches. The Launcher Status display will indicate a momentary <u>RED</u> light as a fault is registered and return to <u>GREEN</u>. The result will be an alternating <u>RED</u> and <u>GREEN</u> light which will continue until test has been successfully completed, or until a fault occurs which is not programmed into the fault circuitry. In this event, the Test Status display which has been indicating <u>WHITE</u> will turn <u>RED</u>; the Launcher Status display will turn <u>RED</u>; and the test will stop.
12.1	START TEST	
12.2	TEST IN PROGRESS	
12.3	PUNCHED TAPE	
12.4	TEST STATUS <u>RED</u>	

ITEM	MAN (OPERATOR)	MACHINE
12.5 TEST STATUS <u>GREEN</u>	Observe color of Test Status display. If <u>GREEN</u> test is successful.	 After successfully punching the last fault on the tape the equipment is automatically returned to its original status and Test Status display indicated <u>GREEN</u> .
12.6 END OF TEST	Operator must disconnect all cables from connector panel at the completion of testing program.	
12.7 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.	 Connector Panel displays will indicate <u>GREEN</u> at end of test cycle.  Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
13.0	<u>TEST TIMER OPERATION</u>	
	Check for compliance with items 1.0 through 2.2.2.1 above.	
	Position Test Selector to "TIMER TEST".	
	Position Timer Selector to reference designation number of timer to be tested.	
13.1	START TEST	 Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
13.2	TEST IN PROGRESS	The purpose of this test is to determine whether or not the timer under test can time out within the allowed time deviation. The timer undergoing test (T_1) will be compared with a standard timer (T_2) located in the test rack. The two timers will start simultaneously and run until they time out and close motor contacts. The timer finishing first will signal a third timer (T_3) to start and measure out the allowed deviation. If the timer in Test (T_1) is fast or slow within the allowed deviation, Test Status display will indicate <u>GREEN</u>.
13.3	TEST STATUS <u>GREEN</u>	   Observe color of Test Status display. If <u>GREEN</u>, test is satisfactorily completed. If, however, (T_1) times out faster or slower than the deviation allowed the Test Status will indicate <u>RED</u>.

ITEM	MAN (OPERATOR)	MACHINE
13.4	TEST STATUS <u>RED</u>	Observe color of Test Status display. If <u>RED</u> , proceed to troubleshoot according to Troubleshooting Manual.
13.5	RESET TIMER TEST	 In order to reset the equipment to pretest conditions press RESET TIMER TEST pushbutton.  Equipment will hold <u>IN TEST</u> when a fault occurs unless released.  RESET TIMER TEST display will change from <u>NO LIGHT</u> to <u>WHITE</u> indicating that resetting is in progress, but incomplete and that a change in the Test Status from <u>RED</u> to <u>GREEN</u> only indicates a <u>Test normal condition</u>.
13.6	END OF TEST	 To complete resetting of equipment.  Press "START" pushbutton with Timer Selector at a timer position.  Press "START" pushbutton with Timer Selector at OFF.  Equipment is reset without going into another test. Operator must disconnect all cables from connector panel at the completion of testing program.
13.7	CONNECTOR PANEL PLUG REMOVAL	 Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder.  Connector panel displays will indicate <u>GREEN</u> at end of test cycle.  Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
14.0	TEST ACTUAL LAUNCHER HARDWARE FROM THE MOBILE TEST RACK	
14.1	COMMAND	Specific permission to perform this test <u>MUST</u> be requested from the proper authority and received by the operator before proceeding further.
14.2	TIMER CHASIS	At the timer chasis:
14.2.1	PLUG 8 & PLUG 11	Disconnect P8 and P11
14.2.2	ADAPTER TO A8A2J8 AND A8A2J11	Plug double end of adapter into J8 and J11.
14.2.3	P8 TO ADAPTER	Plug P8 into single end of adapter (J8).
14.2.4	ADJUST TIMER	The trip setting on timer A8A2MO8 must be changed from a normal value of 1.5 minutes to 5 minutes for this test.
14.3	SUMMED INTERLOCK UMBILICAL RETRACTION ALLOWED SIGNAL	 Adapter switches from timing relay connections to timer connections with longer time delay.
14.3.1	... FROM LAUNCH CONTROLLER	 The summed Interlock Umbilical Retraction Allowed relay must be energized in one of two ways: by signal from the Launch Controller (by others).
14.3.2	... FROM LOCAL SUPPLY	by a 28 volt signal supplied to the relay by jumper.

ITEM	MAN (OPERATOR)	MACHINE
14.3.2.1	GET INFORMATION	Information must be received that umbilical retraction is allowed. This information is the same, in effective protection to equipment, as the Launch Controller signal. Supply a 28 volt signal to the relay by jumper. Check manual for exact procedure. Umbilical connections to the missile must be disconnected by others before retraction mechanisms can be operated.
14.3.2.2	CONNECT JUMPER	
14.4	CONNECTOR PANEL	Observe color of display over First Test Controller connector on the Connector Panel.  Display over First Test Controller connector will indicate <u>GREEN</u> if this test is allowed.
14.4.1	FIRST TEST CONTROLLER	Plug in cable of First Test Controller on <u>GREEN</u> only.
14.4.2	NO OTHER PLUGS	No other plugs should be connected at the Connector Panel.
14.5	LAUNCHER STATUS DISPLAY <u>RED</u>	Observe color of Launcher Status display.  If <u>RED</u>: <u>STOP</u> A non-operational status in any part of the Launcher hardware Will cause the "NO-GO" signal to appear. The Launcher Status display will indicate <u>RED</u>.
14.5.1	REVERSE PROCEDURE	Reverse procedure, disconnect all plugs and jumpers
14.5.2	CHECK NON-OPERATIONAL CONDITION	Check for cause of non-operational condition.
14.6	LAUNCHER STATUS DISPLAY <u>GREEN</u>	Observe color of Launcher Status display.  If <u>GREEN</u> proceed with test. All operational status in all Launcher hardware will cause the "GO" signal to appear. The Launcher Status display will indicate <u>GREEN</u>.

ITEM	MAN (OPERATOR)	MACHINE
14.7	LAMP TEST	Follow lamp testing procedures in items 2.1 through 2.1.3 above.
14.8	HARDWARE MOTION TESTS	Exercise hardware in any test selected on Sequence Selector following procedures described in simulated tests: 3.0; 4.0; 5.0; 6.0; 7.0; 8.0; 9.0; 10.0; 11.0; above. Equipment will follow any test selected on Sequence Selector while Test Selector is set to "SEQUENCE TEST".
14.9	END OF TEST	(Special orders must be given for water spray tests.) All plugs and jumpers must be disconnected at the end of test procedures.
14.10	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Test Controller; First Test Responder and Second Test Responder. Connector Panel displays will indicate <u>GREEN</u> at end of test cycle. Disconnection of cables automatically starts the process of re-correlation of the Function Relays with respect to actual Launcher conditions.

Appendix B

Operating Test Panel-
Human Factors Review OB-TB

AMERICAN MACHINE & FOUNDRY COMPANY
ENGINEERING DIVISION☐ FIELD TRIP REPORT☐ MEETING REPORT☒ ENGINEERING REPORT

Sept. 24, 1959

DATE

ER - TPS - #222

SERIAL NO.

213-4-57

PROJECT OR JOB NO.

1

PAGE

OF

PERIOD COVERED

WRITTEN BY

TO: _____

CUSTOMER: _____

SUBJ.: OPERATING TEST PANEL - _____

ADDRESS: _____

HUMAN FACTORS REVIEW OB-TB

PERSON CONTACTED: _____

1.0 PURPOSE:

1.1 To evaluate existing plans for the WS 107A-2 (OB-TB) Operating Test Panel with respect to established principles and practices of Human Engineering in order to maximize the effectiveness of the weapon system through minimization of human errors in operation.

1.2 To record progress in the cooperative re-design of equipment based upon human factors inputs resulting from previous evaluation of prototype plans.

2.0 SUMMARY:

Following a change of scope (TD #59-4016 stationary consolidation of Test, Logic, and Fault Readout Equipment) the Electro-Mechanical Lab, Stamford, redesigned the OSTF Mobile Test Rack with assistance from the Systems Human Factors Group using criteria established after the Human Factors Review of OSTF plans.

2.1 The components have been located in the equipment racks in the Electrical Room of the Equipment Terminal Silo.

2.2 The DIRECTORY for Launcher Status check-out has been added to the OPERATING PANEL.

2.3 A TEST MODE OPERATING display has been added to indicate whether the equipment is in a SIMULATOR or LAUNCHER Test mode. The display indicates TEST MODE according to the number of plugs connected on the Connector Panel. The LAUNCHER Test mode is related to the position of the Key switch below. An arrow has been used as a visual connection between the LAUNCHER mode designation and the Key Switch. A line connects the correct Key position with #2 on the Test Selector (LAUNCHER TEST) (ACTUAL).

- 2.4 The Key Switch increases the safety factors involved in an ACTUAL LAUNCHER HARDWARE test.
- 2.5 Labeling has been etched into the panel front along with color dots which describe the meaning of each transilluminated light color.
- 2.6 The designation LAUCHER has been changed to SHUTDOWN "SHUTDOWN" on the pushbutton display which functions REVERSE as a reversing control for any test in progress, and indicates WHITE while a test is in the shutdown sequence.
- 2.7 The Lamp Test has been extended to include the displays on the Connector Panel.

3.0 REFERENCES:

- 3.1 The following AMF Drawings were used in the preparation of this report:
 - 59-2-0-1735 OPERATING TEST PANEL - LAYOUT
 - 59-206-1475 CHASSIS, ELECTRICAL EQUIPMENT - CONNECTOR ASSEMBLY
 - 59-206-1601 FRAME ASSEMBLY - STRUCTURE
- 3.2 Information regarding the operation of this equipment was gathered by the writer in conjunction with L. V. Seiden of the Stamford Laboratory.

4.0 MAN-MACHINE ANALYSIS - Future Use.

The Man-Machine Analysis section of this report was written primarily as a guide in the human engineering evaluation of the equipment - however, since it reflects the latest accurate information on the subject, general use of the contents should be made in all tasks where a working analysis of the Operating Test Equipment is required.

TABLE I

MAN-MACHINE ANALYSIS OF THE OPERATING TEST PANEL (OB-TB)

The following is a man-machine analysis of the OPERATING TEST PANEL in its various testing functions. The table is divided into three vertical columns. The first column is an index of separate items or steps in the procedure; the second describes the operator's inputs as he performs each test; and the third briefly outlines the machine's response to controls as the machine and the operator complete each step in the sequence. This analysis has been written with several purposes in mind. It has helped to acquaint the writer with the equipment so that an evaluation of human factors considerations could be made and improvements to the design could follow. This analysis describes the tests which can be performed with the equipment along with the requirements and limitations involved. This analysis can also be used in the field if changes have to be evaluated resulting from the Operational Systems Human Factors Test.

ITEM	MAN (OPERATOR)	MACHINE
1.0	<u>PREPARE FOR TEST</u>	
1.1	<u>COMMAND</u>	Receive command to make a test from proper authority. Displays (lights) indicate plug status: <u>GREEN</u>: go <u>RED</u>: no go above each connector on the Connector Panel.
1.2	CONNECTOR PANEL	
1.2.1		Observe status of lights above connectors on panel. <u>STOP</u> Check for trouble according to <u>Troubleshooting Manual</u>. A <u>RED</u> light in all four displays indicates that equipment is in a condition where connection or disconnection is <u>NOT</u> allowed either due to a fault, or test already in cycle, or local operation.
1.2.2		<u>Proceed</u> A <u>GREEN</u> light displayed over #1 connector indicates that TEST PLUG #1 may be connected.
1.2.3	CONNECT #1 TEST PLUG	The connection of TEST PLUG #1 removes the voltage coming from the Launch Controller signal bus - changes the signals traveling from the AMF Launcher Controller from 28 volts to 3 volts - and connects the Test Controller Equipment parallel to the latter.

ITEM	MAN (OPERATOR)	MACHINE
1.2.4	#2 DISPLAY <u>RED</u>	A failure in connection will cause the #2 display to remain <u>RED</u> .
1.2.5	#2 DISPLAY <u>GREEN</u>	Successful connection of TEST PLUG #1 causes the #2 display to indicate <u>GREEN</u> .
1.2.6	TEST PLUG #2	Green lights in #1 and #2 displays indicate that TEST PLUG #2 may be connected.
1.2.7	#3 and #4 DISPLAY <u>RED</u>	The connection of TEST PLUG #2 removes voltage from the interlock bus and switches the voltage on the solenoid bus from 26 volts to 3 volts.
1.2.8		A failure in connection will cause the #3 and #4 displays to remain <u>RED</u> .
1.2.9	#1 TEST PLUG <u>RED</u>	Successful connection of TEST PLUG #2 will cause the #1 display to indicate <u>RED</u> .
1.2.10	#3 and #4 DISPLAY GREEN	- and display #3 and #4 to indicate <u>GREEN</u> .
		Successful connection of TEST PLUGS #3 and #4 completes connection of the simulator equipment.

ITEM	MAN (OPERATOR)	MACHINE
1.2.11	TEST MODE OPERATING DISPLAY	Observe color of TEST MODE OPERATING display. GREEN indicates successful connection of all test plugs (in the SIMULATOR mode).
1.3	LAMP TESTS	(Note: This test may be performed at any time) Test Lamps in displays as follows:
1.3.1	<u>RED LAMP TEST</u>	Push Lamp Test button designated as <u>RED</u> . Voltage to all lamps other than <u>RED</u> will be temporarily cut off. All <u>RED</u> lamps should light.
		The following displays contain <u>RED</u> lamps:
		On Test Panel:
		LAUNCHER STATUS TEST MODE OPERATING TEST STATUS
		On Connector Panel:
		PLUG STATUS #1, #2, #3, & #4.
		Replace all lamps which fail to light and repeat <u>RED</u> lamp test.
1.3.2	<u>WHITE LAMP TEST</u>	Push lamp test button designated as <u>WHITE</u> . Voltage to all lamps other than <u>WHITE</u> will be temporarily cut off. All <u>WHITE</u> lamps should light.

ITEM

MAN (OPERATOR)

MACHINE

The following displays contain WHITE lamps:

On Test Panel:

TEST STATUS
"SHUTDOWN" REVERSE

1.3.3 GREEN LAMP TEST

Push lamp test button designated as GREEN.

Voltage to all lamps other than GREEN will be temporarily cut off.
All GREEN lamps should light.

The following displays contain GREEN lamps:

On Test Panel:

LAUNCHER STATUS
TEST MODE OPERATING
TEST STATUS

On Connector Panel:

PLUG STATUS #1, #2, #3,
and #4.

1.4 TEST PANEL

Observe the Operating Test Panel displays.

After all plugs have been successfully connected and lamps have been tested positively the Operating Panel should display the following:

1.4.1 LAUNCHER STATUS
GREEN

Observe color of Launcher Status display with Test Selector in the "OFF" position.

Launcher Status GREEN indicates that the function relays related to the simulated launcher are in a "go" or operational status.

ITEM	MAN (OPERATOR)	MACHINE
1.4.2	LAUNCHER STATUS <u>RED</u>	Launcher Status <u>Red</u> indicates that the function relays related to the simulated launcher are in a "go" or operational status.
1.4.3	FUNCTION RELAY CORRELATION	In order to proceed with any test, the Launcher Status display must be <u>GREEN</u>. Push Launcher Status pushbutton. Function relays will correlate with respect to a test "GO" status. A <u>GREEN</u> light will then appear in the Launcher Status display indicating that the function relays are latched in the "GO" condition while actual launcher may remain inoperative.
1.4.4	TEST STATUS <u>GREEN</u>	Test Status - <u>GREEN</u> - indicates that the test equipment is operational or (ready for test).
1.4.5	TEST STATUS <u>NO LIGHT</u>	<u>NO LIGHT</u> indicates that stepping relay is not at normal starting position if <u>GREEN</u> lamp test is positive. (See lamp test above). With Test Selector switch in the "OFF" position, push Test Status button to reset stepper relay. Stepping relay will be returned to normal starting position. Test Status - <u>GREEN</u> will indicate operational conditions.

ITEM	MAN (OPERATOR)	MACHINE
1.5	TEST SIMULATED LAUNCHER STATUS (OPTIONAL) checked at any time after making all connections at the Switching Panel except while a test (selected on Test Selector switch) is in cycle.	Numbers on the DIRECTORY Selector correspond to labels on the DIRECTORY Plate which designate the various test areas. These simulated areas range from OPERATIONAL over-all down through selected subdivisions to ELECTRICAL & HYDRAULIC POWER ON.
1.5.1	SIMULATED LAUNCHER OVER-ALL STATUS Position DIRECTORY Selector to Number 1. If Launcher Status display indicates <u>RED</u> , continue with test of sub-system.	An immediate indication of the simulated over-all Launcher status will appear in the Launcher Status Display. <u>GREEN</u> : go <u>RED</u> : no go
1.5.2	SIMULATED SUB-SYSTEM STATUS Position DIRECTORY Selector to any number from 2 through 20. Continue until <u>RED</u> appears.	An immediate indication of status for the selected simulated subsystem will appear in the Launcher Status display. <u>GREEN</u> : go <u>RED</u> : no go

When Launcher Status indicates RED, troubleshoot for the area indicated according to procedure outlined in Troubleshooting Manual.

ITEM	MAN (OPERATOR)	MACHINE
2.0	TEST FAULT DETECTION, Check for compliance with items 1.0 FAULT LOCATION AND through 1.4.5 above. REGISTRATION CIRCUITRY.	Test Mode display indicates <u>GREEN</u> (SIMULATOR)
2.1	START TEST Press "START" pushbutton and <u>re-</u> <u>lease</u> to start test.	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
2.2	TEST IN PROGRESS The purpose of this test is to deter- mine the capability of the Fault Detection Equipment by simulating and punching out every possible fault on the Fault readout equipment.	Fault signals are simulated which will cause every fault to be regis- tered on the punched tape along with periodic fault check punches. Disregard Launcher Status display until test has been successfully completed, or until a fault occurs which is not programmed into the fault circuitry. In this event, the Test Status display which has been indicating <u>WHITE</u> will turn <u>RED</u> ; and the test will stop.
2.3	PUNCHED TAPE The <u>Manual</u> should be consulted for correct method for reading the punched tape.	
2.4	TEST STATUS <u>RED</u> Observe color of Test Status display. If <u>RED</u> proceed with troubleshooting according to <u>Troubleshooting Manual</u> .	

ITEM	(MAN) OPERATOR	MACHINE
2.5	TROUBLESHOOT AND RETEST When fault has been corrected following troubleshooting procedure reset and repeat test as follows:	
2.5.1	FUNCTION RELAY CORRELATION (TEST RESET) Push the Launcher Status pushbutton.	Correlation of the Function. Relays with respect to a test "GO" status will return Launcher Status to <u>GREEN</u>.
2.5.2	REPEAT TEST Follow through all of the steps in this test starting with 2.0.	
2.6	TEST STATUS <u>GREEN</u> Observe color of Test Status display. If <u>GREEN</u> test is successful	After successfully punching the last fault on the tape the equipment is automatically returned to its original status and Test Status display indicates <u>GREEN</u>.
2.7	END OF TEST Operator must disconnect all plugs from connector panel at the completion of the last test in any testing program.	
2.7.1	CONNECTOR PANEL PLUG REMOVAL Plugs should be disconnected in the following preferred sequence: 4 3 2 1 G G G R Observe Connector Panel Displays. 4 3 2 1 R R G G Remove plugs #4, #3, and #2	Displays will indicate <u>GREEN</u> when plugs can be removed. Removal of plugs #4, #3, and #2 will cause Connector Panel Displays to indicate <u>RED</u>; <u>RED</u>; <u>GREEN</u>; <u>GREEN</u> respectively.

ITEM	MAN (OPERATOR)				MACHINE
	4	3	2	1	
	☐ R	☐ R	☐ R	☐ G	
	Remove plug #1				#1 Display will stay GREEN when #1 plug is removed and cause #4 #3 and #2 to indicate RED.
2.7.2	RECORRELATION (AUTOMATIC)				Disconnection of plugs automatically starts the process of re-correlation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

ITEM	MAN (OPERATOR)	MACHINE
3.0	TEST SHUTDOWN COMMAND AFTER HYDRAULIC POWER PACK ON COMMAND Check for compliance with items 1.0 through 1.4.5 Position Test Selector to #7 POWER PACK ON	Test Mode display indicates <u>GREEN</u> (SIMULATOR).
3.1	START TEST Press "START" pushbutton and <u>release</u> to start test.	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
3.2	TEST IN PROGRESS The purpose of this test is to determine whether or not SHUTDOWN command signal can be received by the Function Relays immediately after HYDRAULIC POWER PACK operating signal has been simulated.	Function Relays are exercised in all of the steps of the sequence normally followed from SHUTDOWN to the point where the POWER PACK is ON and back to SHUTDOWN. The sequence will continue until successful completion of the test (in this event, the Test Status display indicates <u>GREEN</u>; or in case of failure test immediately stops and causes the Test Status display to indicate <u>RED</u>).
3.3	TEST STATUS <u>RED</u> Observe Test Status Display.	After the Test Status display indicates that a fault has occurred the Launcher Status display will indicate that the Fault Punch has completed punching out the fault by switching to <u>RED</u>.

ITEM	MAN (OPERATOR)	MACHINE
3.4	LAUNCHER STATUS <u>RED</u>	Observe Launcher Status display. If the Test Status and the Launcher Status displays both show <u>RED</u> proceed as follows: If the "SHUTDOWN" REVERSE display indicates <u>WHITE</u> observe the punch code on the fault punch tape and proceed to troubleshoot according to the procedure outlined in the <u>Troubleshooting Manual</u>. When fault has been corrected following troubleshooting procedure reset and repeat test. Push the Launcher Status pushbutton.
3.5	"SHUTDOWN" REVERSE <u>WHITE</u>	If the test has successfully stepped to the command position set on the Sequence Selector and is returning to SHUTDOWN when a fault occurs the "SHUTDOWN" REVERSE display will indicate <u>WHITE</u>.
3.5.2	TROUBLESHOOT AND RETEST	
3.5.2.1	FUNCTION RELAY CORRELATION (TEST RESET)	Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u>
3.5.2.2	REPEAT TEST	
3.6	"SHUTDOWN" REVERSE	"SHUTDOWN" REVERSE NO LIGHT indicates that the test is in the forward or up-moving sequence. Depressing the "SHUTDOWN" REVERSE pushbutton simulates action that would normally (actual hardware movement as controlled by others) take place at the launch controller in case of fault. When this pushbutton
3.6.1	RETURN TO SHUTDOWN	Follow through all of the steps in this test starting with 3.0. If the "SHUTDOWN" REVERSE display indicates <u>NO LIGHT</u> push the display button.

ITEM	MAN (OPERATOR)	MACHINE
------	----------------	---------

is depressed it will display WHITE light and the Test Status display should turn from RED to WHITE indicating that the test is in progress again in the return sequence.

3.6.2	<u>TEST STATUS RED</u>	Observe Test Status Display	Should another fault occur during this sequence the test status display will indicate <u>RED</u> .
3.6.3	FAULT PUNCH TAPE	Observe fault punch tape as before for the punched out fault.	Upon completion of punching out the fault the Launcher Status display will again indicate <u>RED</u> .
3.7	TROUBLESHOOT AND RETEST	Troubleshoot according to the procedure outlined in the <u>Troubleshooting Manual</u> . When fault has been corrected reset and repeat test.	
3.7.1	FUNCTION RELAY CORRELATION (TEST RESET)	Push the Launcher Status pushbutton.	Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u> .
3.7.2	REPEAT TEST	Follow through all of the steps in this test starting with 3.0	
3.8	<u>TEST STATUS GREEN</u>	Observe color of Test Status display at successful completion of test.	Should no fault occur during the return to SHUTDOWN, the Test Status display will indicate <u>GREEN</u> .

ITEM	MAN (OPERATOR)	MACHINE
3.9	END OF TEST	Operator must disconnect all plugs from Connector Panel at the completion of the last test in any testing program.
3.10	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence:
	4 3 2 1 G G G R	Displays will indicate <u>GREEN</u> when plugs can be removed.
	4 3 2 1 R R G G	Removal of plugs #4, #3, and #2 will cause Connector Panel Displays to indicate <u>RED</u> ; <u>RED</u> ; <u>GREEN</u> ; <u>GREEN</u> respectively.
	4 3 2 1 R R R G	#1 Display will stay <u>GREEN</u> when #1 plug is removed and cause #4, #3 and #2 to indicate <u>RED</u> .
3.11	RECORRELATION (AUTOMATIC)	Disconnection of plugs automatically starts the process of recorrelation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

ITEM	MAN (OPERATOR)	MACHINE
4.0	TEST SHUTDOWN COM- MAND DURING DOOR OPENING	Test Mode Display indicates <u>GREEN</u> (SIMULATOR).
4.1	START TEST	Position Test Selection to #6 DOOR OPEN. Press "START" pushbutton and <u>release</u> to start test. The purpose of this test is to deter- mine whether or not the SHUTDOWN command signal can be received by the Function Relays immediately after Door <u>IN MOTION</u> signal has been simulated.
4.2	TEST IN PROGRESS	Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point during <u>DOOR MOTION</u> back to SHUTDOWN. The sequence will continue until successful completion of the test (in this event, Test Status display indicated <u>GREEN</u>) or in case of failure test immediately stops and causes the Test Status dis- play to indicate <u>RED</u> .
4.3	ANALYSIS OF INDICATOR LIGHT COLORS.	Follow items 3.3 through 3.7 above.
4.4	END OF TEST	Operator must disconnect all plugs from connector panel at the comple- tion of the last test in any testing program.
4.4.1	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence. Observe Connector Panel Displays
	4 3 2 1 [G] [G] [G] [R]	Displays will indicate <u>GREEN</u> when plugs can be removed.

ITEM	MAN (OPERATOR)				MACHINE
	4	3	2	1	Removal of plugs #4, #3, and #2 will cause Connector Panel Displays to indicate <u>RED</u> ; <u>RED</u> ; <u>GREEN</u> ; <u>GREEN</u> respectively.
	R	R	G	G	
	4	3	2	1	#1 Display will stay <u>GREEN</u> when #1 plug is removed and cause #4, #3 and #2 to indicate <u>RED</u> .
	R	R	R	G	
4.4.2	RECORRELATION (AUTOMATIC)				Disconnection of plugs automatically starts the process of re-correlation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

ITEM	MAN (OPERATOR)	MACHINE
5.0	TEST SHUTDOWN COMMAND AFTER LAUNCHER PLATFORM UP	Test mode display indicates <u>GREEN</u> (SIMULATOR).
5.1	START TEST	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
5.2	TEST IN PROGRESS	The Test Responder receives Function Relay signals which would be received in actual operation (while platform is being locked) by the Launcher solenoids. The Test Controller sends to the Function Relays, signals which would be sent in actual cycle of operation by the Launcher limit switches and interlocks. In this manner the Function Relays are exercised through all of the steps required to initiate and complete locking of the Platform and return to "SHUTDOWN" stopping only upon successful completion of test (in event Test Status display indicates <u>GREEN</u>); or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>.

ITEM	MAN (OPERATOR)	MACHINE
5.3	TEST STATUS <u>RED</u>	Observe Test Status Display. After the Test Status Display indicates that a fault has occurred the Launcher Status display will indicate that the Fault Punch has completed punching out the fault by switching to <u>RED</u>.
5.4	LAUNCHER STATUS <u>RED</u>	Observe Launcher Status Display. If the Test Status and the Launcher Status displays both show <u>RED</u> proceed as follows: If the test has successfully stepped to the command position set on the Sequence Selector and is returning to shutdown when a fault occurs the "SHUTDOWN" REVERSE display will indicate <u>WHITE</u>.
5.5	"SHUTDOWN" REVERSE <u>WHITE</u>	If the "SHUTDOWN" REVERSE display indicates <u>WHITE</u> observe the punch code on the fault punch tape and proceed to troubleshoot according to the procedure outlined in the <u>Troubleshooting Manual</u>.
5.5.1	FAULT PUNCH TAPE	
5.5.2	TROUBLESHOOT AND RETEST	When fault has been corrected following troubleshooting procedure reset and repeat test.
5.5.3	FUNCTION RELAY CORRELATION (TEST RESET)	Push the Launcher Station pushbutton. Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u>.
5.5.4	REPEAT TEST	Follow through all of the steps in this test starting with 5.0.
5.6	"SHUTDOWN" REVERSE	"SHUTDOWN" REVERSE <u>NO LIGHT</u>

ITEM	MAN (OPERATOR)	MACHINE
RETURN TO SHUTDOWN	If the "SHUTDOWN" REVERSE display indicates <u>NO LIGHT</u> push the display button.	Depressing the "SHUTDOWN" REVERSE Pushbutton simulates action that would normally (actual hardware movement as controlled by others) take place at the launch controller in case of fault. When this pushbutton is depressed it will display <u>WHITE</u> light and the Test Status display should turn from <u>RED</u> to <u>WHITE</u> indicating that the test is in progress again in the return sequence
5.6.1 TEST STATUS <u>RED</u>	Observe Test Status Display	Should another fault occur during this sequence the test status display will indicate <u>RED</u> .
5.6.1.1 FAULT PUNCH TAPE	Observe fault punch tape as before for the punched out fault.	Upon completion of punching out the fault the Launcher Status display will again indicate <u>RED</u> .
5.6.1.2 TROUBLESHOOT AND RETEST	Troubleshoot according to the procedure outlined in the Troubleshooting Manual and repeat entire test as outlined above.	
5.6.1.3 FUNCTION RELAY CORRELATION	Push the Launcher Status Button.	Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u> .
5.6.1.4 REPEAT TEST	Follow through all of the steps in this test starting with 5.0.	
5.6.2 TEST STATUS <u>GREEN</u>	Observe color of Test Status display at successful completion of test.	Should no fault occur during the return to SHUTDOWN, the Test Status display will indicate <u>GREEN</u> .

ITEM	MAN (OPERATOR)	MACHINE
5.6.2.1 RESTORE TO PRETEST CONDITIONS	Restore test system to pretest conditions as follows:	Launcher Status <u>RED</u> in combination with a Test Status <u>GREEN</u> indicates a successful, but incomplete test.
5.6.2.2 EXTEND LOCAL UMBILICALS TEST (SEE 10.0)	1. Complete the last phase of the test. Without actually moving hardware Set the Test Selector to #9 EXTEND the operability of the umbilical mechanisms is tested to ascertain whether or not they can be extended by their local controls when needed. OR 2. Push the Launcher Status Button.	
5.6.2.3 FUNCTION RELAY CORRELATION		Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u> .
5.7 END OF TEST	Operator must disconnect all plugs from connector panel at the completion of the last test in any testing program.	
5.7.1 CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence: Observe Connector Panel Displays.	Displays will indicate <u>GREEN</u> when plugs can be removed.
	4 G 3 G 2 G 1 R 4 R 3 R 2 G 1 G 4 R 3 R 2 R 1 G	Removal of plugs #4, #3, and #2 will cause Connector Panel Displays to indicate <u>RED</u> ; <u>RED</u> ; <u>GREEN</u> ; <u>GREEN</u> respectively.
	Remove Plugs #4, #3, and #2	
	Remove Plug #1	Removal of plug #1 will change #1 display to <u>GREEN</u> and cause #4, #3 and #2 to indicate <u>RED</u> .

ITEM

MAN (OPERATOR)

MACHINE

5.7.2 RECORRELATION (AUTOMATIC)

Disconnection of plugs automatically starts the process of re-correlation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

ITEM	MAN (OPERATOR)	MACHINE
6.0	TEST LOWER LAUNCHER AFTER ENGINE SPRAY Check for compliance with 1.0 through 1.4.5 above. Position Test Selector to #4 ENGINE SPRAY. Press "START" pushbutton and <u>release</u> Test Status display turns from "<u>GREEN</u>" to <u>WHITE</u> indicating test in progress.	Test Mode display indicates <u>GREEN</u> (SIMULATOR).
6.2	TEST IN PROGRESS The purpose of this test is to determine whether or not the LOWER LAUNCHER command signal can be received by the Function Relays immediately after ENGINE SPRAY has been simulated.	Function Relays are exercised in all of the steps in the sequence normally followed from SHUTDOWN to a point after (SIMULATE)ENGINE SPRAY and back to LAUNCHER LOWERED condition. The sequence will continue until successful completion of the test (in this event, Test Status display indicates <u>GREEN</u>, or in case of failure test immediately stops and causes the Test Status display to indicate <u>RED</u>).
6.3	ANALYSIS OF INDICATOR LIGHT COLORS Follow items 5.3 through 5.7.1.2 above.	
6.4	END OF TEST Operator must disconnect all plugs from Connector Panel at the completion of any testing period.	
6.4.1	CONNECTOR PANEL PLUG REMOVAL Plugs should be disconnected in the following preferred sequence:	
	4 3 2 1 G G G R Observe Connector Panel Displays	Displays will indicate <u>GREEN</u> when plugs can be removed.

ITEM

MAN (OPERATOR)

MACHINE

4	R	3	R	2	G	1	G
---	---	---	---	---	---	---	---

Remove plugs #4, #3, and #2

Removal of plugs #4, #3, and #2, will cause Connector Panel Displays to indicate RED; RED; GREEN; GREEN respectively.

4	R	3	R	2	R	1	G
---	---	---	---	---	---	---	---

Remove plug #1

#1 Display will stay GREEN when #1 plug is removed and cause #4, #3, and #2 to indicate RED.

6.4.2 RECORRELATION (AUTOMATIC)

Disconnection of plugs automatically starts the process re-correlation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

ITEM	MAN (OPERATOR)	MACHINE
7.0	TEST NORMAL CYCLE (SIMULATED)	Test Mode display indicates <u>GREEN</u> (SIMULATOR)
	Check for compliance with items 1.0 through 1.4.5 above.	
	Position Test Selector Switch to #3 <u>COMPLETE NORMAL FIRE.</u>	
7.1	START TEST	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
7.2	TEST IN PROGRESS	The Test Responder receives Function Relay signals which would be received in actual firing cycle by the Launcher solenoids. The Test controller sends to the Function Relays signals which would be sent in actual firing cycle by the Launcher limit switches and interlocks. In this manner the Function Relays are exercised through all the steps required to initiate and complete the normal firing cycle, cool the Launcher equipment, and return to LAUNCHER LOWERED condition; stopping only upon successful completion of the test (in this event Test Status display indicates <u>GREEN</u>; or in case of failure which immediately stops the test and causes the Test Status display to indicate <u>RED</u>). The purpose of this test is to determine whether or not the LOWER LAUNCHER command signal can be received by the Function Relays and correct action be taken after FIRING (without the actual firing of a missile)
7.3	ANALYSIS OF INDICATOR LIGHT COLORS	Follow items 5.3 through 5.6.10.2 above.

ITEM	MAN (OPERATOR)	MACHINE
7.4	END OF TEST	Operator must disconnect all plugs from connector Panel at the completion of any testing program.
7.4.1	CONNECTOR PANEL PLUG REMOVAL	Plugs should be disconnected in the following preferred sequence:
	4 G 3 G 2 G 1 R	Observe Connector Panel Displays
	4 R 3 R 2 G 1 G	Remove plugs #4, #3, and #2
	4 R 3 R 2 R 1 G	Remove Plug #1
7.4.2	RECORRELATION (AUTOMATIC)	Displays will indicate <u>GREEN</u> when plugs can be removed. Removal of plugs #4, #3 and #2 will cause Connector Panel Displays to indicate <u>RED</u>; <u>RED</u>; <u>GREEN</u>; <u>GREEN</u> respectively. #1 Display will stay <u>GREEN</u> when #1 plug is removed and cause #4, #3 and #2 to indicate <u>RED</u>. Disconnection of plugs automatically starts the process of re-correlation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

ITEM	MAN (OPERATOR)	MACHINE
8.0	TEST LAUNCHER (SIMULATED)	Check for compliance with items 1.0 through 1.4.5 above. Test Mode Display indicates <u>GREEN</u> (SIMULATOR).
8.1	KEY SWITCH <u>OFF</u>	Key Switch must be in the <u>OFF</u> position.
8.2	OPERATING PANEL	Position Test Selector to #2 LAUNCHER TEST
8.3	START TEST	Press "START" pushbutton Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
8.4	TEST IN PROGRESS	The Test Responder receives Function Relay signals which would be received in actual firing cycle by the Launcher solenoids. The Test Controller sends to the Function Relays signals which would be sent in an actual firing cycle by the launcher limit switches and interlocks. In this manner, the Function Relays are exercised through all of the steps required to initiate and complete the normal firing cycle with the exception of Launcher cooling and fire fighting equipment and return to LAUNCHER LOWERED condition, stopping only upon successful completion of the test (in this event Test Status display indicates <u>GREEN</u> or in case of failure which immediately stops the test and causes the test Status display to indicate <u>RED</u> .

ITEM	MAN (OPERATOR)	MACHINE
8.5	TEST STATUS <u>GREEN</u> ; LAUNCHER STATUS <u>RED</u>	The EXTENDED LOCAL UMBILICALS TEST will not be automatically performed as part of the LAUNCHER (SIMULATED) TEST. The Launcher Status Display will remain <u>RED</u> until the operator has completed one of the following steps.
8.5.1	RESTORE TO PRETEST CONDITIONS	Launcher Status <u>RED</u> in combination with a Test Status <u>GREEN</u> indicates a successful, but incomplete test.
8.5.1.1	EXTEND LOCAL UMBILICALS TEST (SEE 10.0)	Without actually moving hardware the operability of the umbilical mechanism is tested to ascertain whether or not they can be extended by their local controls when needed.
8.5.1.2	FUNCTION RELAY CORRELATION	Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u> .
8.6	TEST STATUS <u>GREEN</u> , LAUNCHER STATUS <u>GREEN</u>	Proceed to end of test
8.7	TEST STATUS <u>RED</u>	After the Test Status display indicates that a fault has occurred the Launcher Status display will indicate that the Fault Punch has completed out the Fault by switching to <u>RED</u> .

ITEM	MAN (OPERATOR)	MACHINE
8.8	LAUNCHER STATUS <u>RED</u>	Observe Launcher Status Display. If the Test Status and the Launcher Status displays both show <u>RED</u> proceed as follows: If the test has successfully stopped to the command position set on the Sequence Selector and is returning to SHUTDOWN when a fault occurs the SHUTDOWN REVERSE display will indicate <u>WHITE</u>.
8.9	"SHUTDOWN" REVERSE <u>WHITE</u>	If the "SHUTDOWN" REVERSE display indicates <u>WHITE</u> observe the punch code on the fault punch tape and proceed to troubleshoot according to the procedure outlined in the <u>Troubleshooting Manual</u>.
8.9.1	FAULT PUNCH TAPE	
8.9.2	TROUBLESHOOT AND RETEST	When fault has been corrected following troubleshooting procedure reset and repeat test.
8.9.3	FUNCTION RELAY COR- RELATION (TEST RESET)	Push the Launcher Status Pushbutton.
8.9.4	REPEAT TEST	Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u>.
8.10	"SHUTDOWN" REVERSE RETURN TO SHUTDOWN	"SHUTDOWN" REVERSE <u>NO LIGHT</u> indicates that the test is in the forward or up-moving sequence. Depressing the "SHUTDOWN" REVERSE pushbutton simulates action that would normally (actual hardware movement as controlled by others) take place at the launch controller in case of fault.

ITEM	MAN (OPERATOR)	MACHINE
		When this pushbutton is depressed it will display <u>WHITE</u> light and the Test Status display should turn from <u>RED</u> to <u>WHITE</u> indicating that the test is in progress again in the return sequence.
8.10.1	<u>TEST STATUS RED</u> Observe Test Status Display.	Should another fault occur during this sequence the Test Status display will indicate <u>RED</u> .
8.10.2	<u>FAULT PUNCH TAPE</u> Observe fault punch tape as before for the punched out fault.	Upon completion of punching out the fault the Launcher Status display will again indicate <u>RED</u> .
8.10.3	<u>TROUBLESHOOT AND RETEST</u> Troubleshoot according to the procedure outlined in the <u>Troubleshooting Manual</u> . When fault has been corrected reset and repeat test.	
8.10.4	<u>FUNCTION RELAY CORRELATION (TEST RESET)</u> Push the Launcher Status pushbutton.	Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to <u>GREEN</u> .
8.10.5	<u>REPEAT TEST</u> Follow through all of the steps in this test starting with 8.0.	
8.11	<u>TEST STATUS GREEN</u> <u>LAUNCHER STATUS RED</u> Observe color of Test Status display at successful completion of test.	Should no fault occur during the re-turn to <u>SHUTDOWN</u> , the Test Status

ITEM

MAN (OPERATOR)

MACHINE

display will indicate GREEN. However, the EXTENDED umbilicals test will not be automatically performed as part of the LAUNCHER (SIMULATED) Test. The Launcher Status Display will remain RED until the operator has completed one of the following steps:

8.11.1 RESTORE TO PRETEST CONDITIONS Restore test system to pretest conditions as follows:

8.11.1.1 EXTEND LOCAL UMBILICALS TEST (SEE 10.0) 1. Complete the last phase of the test. Set the Test Selector to #9 extend LOCAL UMBILICALS Test and press "START" push-button.

OR

8.11.1.2 FUNCTION RELAY CORRELATION 2. Push the Launcher Status Button.

Correlation of the Function Relays with respect to a test "GO" status will return Launcher Status display to GREEN.

8.12 END OF TEST Operator must disconnect all plugs from Connector Panel at the completion of any testing program.

8.12.1 CONNECTOR PANEL PLUG REMOVAL Plugs should be disconnected in the following preferred sequence:

4	3	2	1
G	G	G	R

Displays will indicate GREEN when plugs can be removed.

ITEM	MAN (OPERATOR)				MACHINE
	4	3	2	1	Removal of plugs #4, #3 and #2 will cause Connector Panel Displays to indicate <u>RED</u> ; <u>RED</u> ; <u>GREEN</u> ; <u>GREEN</u> respectively.
	R	R	G	G	
	4	3	2	1	#1 Display will stay <u>GREEN</u> when #1 plug is removed and cause #4, #3 and #2 to indicate <u>RED</u> .
	R	R	R	G	
8.12.2 RECORRELATION (AUTOMATIC)	Remove plug #1				Disconnection of plugs automatically starts the process of re-correlation of the Function Relays with respect to actual launcher conditions.

ITEM	MAN (OPERATOR)	MACHINE
9.0	TEST ACTUAL LAUNCHER HARDWARE FROM THE TEST PANEL	For safety purposes, it is recommended that this test be performed directly after LAUNCHER TEST (SIMULATED).
9.1	<u>COMMAND</u>	Specific permission to perform this test MUST be requested from the proper authority and received by the operator before proceeding further.
9.2	SUMMED INTERLOCK UMBILICAL RETRACTION ALLOWED SIGNAL	When contact closing has been accomplished continue test procedure.
9.3	CONNECTOR PANEL	A contact closure of actual equipment will be supplied by an outside source (Launch Controller).
9.3.1	WHEN FOLLOWING A SIMULATOR TEST	<u>GREEN</u> lights displayed over connector plugs indicate that disconnection is allowed.
9.3.2	WHEN NO PLUGS HAVE BEEN DISCONNECTED	Display over #1 TEST PLUG will indicate <u>GREEN</u> if this test is allowed.
9.3.2.1	TEST PLUG #1	Connector Panel displays will indicate: #4 - <u>RED</u> ; #3 - <u>RED</u> ; #2 - <u>GREEN</u> ; and #1 - <u>GREEN</u> .
9.3.2.2	NO OTHER PLUGS	No other plugs should be connected at the Connector Panel.

ITEM	MAN (OPERATOR)	MACHINE
9.4	LAMP TEST	Follow lamp testing procedures in item 1.3 above.
9.5	LAUNCHER STATUS DISPLAY	Observe color of Launcher Status display, If <u>RED</u> ; <u>STOP</u> A non-operational status in any part of the Launcher Hardware will cause the "NO GO" signal to appear. The Launcher Status display will indicate <u>RED</u> .
9.5.1	CHECK NON-OPERATIONAL CONDITION	Check for cause of non-operational condition as follows:
9.5.1.1	TEST ACTUAL LAUNCHER STATUS (DIRECTORY)	With TEST PLUG #1 connected the Launcher Status display may be used to test for the operational status of ACTUAL launcher equipment. Numbers on DIRECTORY selector correspond to labels on the DIRECTORY Plate which designate the various test areas. These areas range from Launcher Over-all "OPERATIONAL" down through selected subdivisions to "ELECTRICAL & HYDRAULIC POWER ON".
9.5.1.2	LAUNCHER OVER-ALL STATUS	The purpose of this test is to determine the operational status of <u>ACTUAL</u> Launcher equipment. This test may be performed at any time while #1 TEST PLUG is connected and other tests are not in progress. Position DIRECTORY Selector to Number 1. Observe color of Launcher Status display. If <u>RED</u>, continue to test subsystem status. An immediate indication of over-all launcher status will appear in the Launcher Status display. <u>GREEN</u>: go <u>RED</u>: no go

ITEM	MAN (OPERATOR)	MACHINE
9.5.1.3 SUBSYSTEM STATUS	Position DIRECTORY Selector to any number from 2 through 20. Observe color of Launcher Status Display. Continue until <u>RED</u> reappears.	An immediate indication of status for the selected sub-system will appear in the Launcher Status display. <u>GREEN</u>: go <u>RED</u>: no go
9.5.2 LAUNCHER STATUS DISPLAY <u>RED</u>	When Launcher status indicates <u>RED</u> troubleshoot for the area indicated according to procedure outlined in <u>Troubleshooting Manual</u> .	
9.5.3 LAUNCHER STATUS DISPLAY <u>GREEN</u>	Observe color of Launcher status display. If <u>GREEN</u> , proceed with ACTUAL LAUNCHER HARDWARE test.	An operational status of all Launcher hardware will cause the "GO" signal to appear. The Launcher Status will indicate <u>GREEN</u>.
9.6 KEY SWITCH	Turn Key Switch to "ON".	Test Mode display indicates <u>RED</u> (LAUNCHER)
9.7 OPERATING PANEL	Position Test Selector Switch to #2 LAUNCHER TEST.	
9.8 START TEST	Press "START" pushbutton and <u>release</u> to start test.	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress.
9.9 TEST IN PROGRESS	The purpose of this test is to exercise ACTUAL LAUNCHER hardware.	Actual hardware is exercised through all of the steps in the sequence followed in a normal firing cycle with the exception of actual firing and water spray.

ITEM

MAN (OPERATOR)

MACHINE

The sequence continues until successful completion of the test (in this event Test Status display indicates GREEN) or until a fault occurs which stops the test and causes the Test Status display to indicate RED.

9.10 TEST STATUS GREEN
LAUNCHER STATUS RED

Observe color of Launcher Status display while Test Status display indicates GREEN.

If the test equipment has successfully returned the ACTUAL LAUNCHER HARDWARE to pretest conditions the actual umbilicals will still be retracted causing a RED indication to appear in the Launcher Status display.

9.10.1 LOCAL UMBILICAL
RE-INSERTION

If Launcher Status indicated RED while test status indicates GREEN ACTUAL UMBILICAL EXTENDING must be accomplished by local controls, in the Missile Silo.

Technicians must be sent into the Missile Silo to extend umbilicals.

Local extension of umbilicals will cause the Launcher Status display to indicate GREEN.

Proceed to END OF TEST (9.15)

9.11 TEST STATUS RED
LAUNCHER STATUS RED

Observe color of Launcher Status display while Test Status display indicates RED.

A failure will cause the equipment to stop in cycle - power will remain

ITEM	MAN (OPERATOR)	MACHINE
------	----------------	---------

		on- and the equipment can be returned to its pretest position providing the "SHUTDOWN" "REVERSE" display indicates <u>NO LIGHT</u> .
9.11.1	"SHUTDOWN" REVERSE	Depressing the "SHUTDOWN" REVERSE pushbutton will cause it to turn <u>WHITE</u> . The Test Status display will change from <u>RED</u> to <u>WHITE</u> indicating that the <u>ACTUAL LAUNCHER HARDWARE</u> test is in the reverse sequence.
9.11.2	UMBILICALS NOT RETRACTED	If the test is reversed before the actual umbilicals have been retracted the Launcher Status display will indicate <u>GREEN</u> when reverse sequence has been successfully completed.
9.11.3	FAULT PUNCH TAPE	Observe Fault Punch tape for location of fault and type of failure.
9.11.4	TROUBLESHOOT	Troubleshoot according to procedures in <u>Troubleshooting Manual</u> .
9.12	TEST STATUS <u>RED</u> LAUNCHER STATUS <u>RED</u> "SHUTDOWN" REVERSE <u>WHITE</u>	If a failure occurs while the test is in the reverse cycle the test will stop, the Launcher Status and Test Status displays will indicate <u>RED</u> and the "SHUTDOWN" REVERSE display will indicate <u>WHITE</u> .

ITEM	MAN (OPERATOR)	MACHINE
9.12.1	PRETEST CONDITIONS	If a failure occurs while test is in the reverse sequence, then a special procedure must be followed to separately return the actual hardware and the test equipment to pretest conditions.
9.12.2	TROUBLESHOOTING MANUAL	Refer the the special procedures outlined in the <u>Troubleshooting Manual</u>.
9.13	CATASTROPHIC FAILURE	Observe the Fault Punch Tape for type of failure. When a failure causes equipment to move out of sequence and without direction it is considered a catastrophic failure. This can occur at any time in the test sequence. A catastrophic failure will automatically shut off power to the actuator and control circuitry before any additional movement of hardware can take place.
9.13.1	LOCAL INSPECTION IN SILO	In a catastrophic situation technicians must enter the missile silo and determine whether the Launcher can be physically SHUTDOWN without causing greater damage. Refer to <u>Troubleshooting Manual</u> for procedures to be followed in resetting and retesting after a catastrophic failure.

ITEM	MAN (OPERATOR)	MACHINE
9.14	CAUTION	The ACTUAL LAUNCHER must be returned to pretest position before another test can be performed.
9.15	END OF TEST	Test Plug #1 may be disconnected at end of test procedures.
9.15.1	CONNECTOR PANEL PLUG REMOVAL	Plug #1 should be disconnected while corresponding display is <u>GREEN</u>. 4 R 3 R 2 G 1 G 4 R 3 R 2 R 1 G

ITEM	MAN (OPERATOR)	MACHINE
10.0	TEST LOCAL UMBILICAL RE-INSERTION CAPABILITY (SIMULATED)	This test is automatically performed in each of the following tests if they finish a normal cycle without failure. NORMAL CYCLE ENGINE SPRAY PLATFORM UP ACTUAL Umbilicals must be locally inserted after LAUNCHER TEST (LAUNCHER) Whenever the "SHUTDOWN" RE- VERSE pushbutton has been used to reverse a test, the LOCAL UMBIL- ICAL test must be performed before the Launcher Status display will indicate <u>GREEN</u> . Preliminary compliance with 1.0 through 1.3.3 is required unless this test follows as part of a previous simulator test. Position Test Selector to #9 EXTEND- ED UMBILICALS. Press "START" pushbutton and <u>re- lease</u> to start test.
10.1	"SHUTDOWN" REVERSE STATUS	"SHUTDOWN" REVERSE display indicates <u>NO LIGHT</u> when a test has not started the reverse cycle. Launcher Status display indicates <u>RED</u> when a test is incomplete or when a fault has been punched out.
10.2	PREPARE FOR TEST (EXTENDED UMBILICALS)	Test Mode display indicates <u>GREEN</u> (SIMULATOR)
10.3	START TEST	Test Status display turns from <u>GREEN</u> to <u>WHITE</u> indicating test in progress. "SHUTDOWN" REVERSE display changes from <u>NO LIGHT</u> to <u>WHITE</u> indicating that the test is in the reverse cycle.

ITEM	MAN (OPERATOR)	MACHINE
10.4	TEST IN PROGRESS	Without actually moving hardware the operability of the umbilical relays is tested to ascertain whether or not the mechanisms can be extended by local controls through function relays when needed.
10.5	LAUNCHER STATUS <u>GREEN</u> TEST STATUS <u>GREEN</u>	Successful completion of the test will cause the Test Status and Launcher Status Displays to indicate <u>GREEN</u> .
10.6	LAUNCHER STATUS <u>RED</u> TEST STATUS <u>RED</u>	A failure in the test will cause the Test Status and Launcher Status to indicate <u>RED</u> .
10.7	END OF TEST	
10.7.1	CONNECTOR PANEL PLUG REMOVAL	
	4 3 2 1 G G G R	Observe Connector Panel Displays
	4 3 2 1	Remove plugs #4, #3 and #2.
	R R G G	Displays will indicate <u>GREEN</u> when plugs can be removed.
		Removal of plugs #4, #3 and #2 will cause Connector Panel Displays to indicate <u>RED</u> ; <u>RED</u> ; <u>GREEN</u> ; <u>GREEN</u> respectively.

ITEM

MAN (OPERATOR)

MACHINE

4 3 2 1
[R] [R] [R] [G]

Remove plug #1

#1 Display will stay GREEN when
#1 plug is removed and cause
#4, #3 and #2 to indicate RED.

10.7.2 RECORRELATION (AUTOMATIC)

Disconnection of plugs automatically starts the process of re-correlation of the Function Relays with respect to ACTUAL LAUNCHER conditions.

B-47

HUMAN INITIATED FAILURE ANALYSIS
OF THE
TITAN LAUNCHER SYSTEM

APPENDIX "C"

FORM RD 72-A

AMERICAN MACHINE & FOUNDRY COMPANY
ENGINEERING DIVISION

- ☐ FIELD TRIP REPORT
☐ MEETING REPORT
☒ ENGINEERING REPORT

4/5/61
DATE
232-5-67
PROJECT OR JOB NO.
12/11/60-4/5/61
PERIOD COVERED
ER-T/S-5116
SERIAL NO.
PAGE
WRITTEN BY

TO: _____

CUSTOMER: _____

SUBJ.: Human Factors Analysis of the Titan

ADDRESS: _____

Launcher System - Final Report

PERSON CONTACTED: _____

1.0 PURPOSE:

To insure that the TITAN LAUNCHER human operated controls and the logic system cannot allow damage to equipment to be caused by any combination of human failure, simple or complex.

2.0 ACTION ITEMS:

2.1 Present EMERGENCY STOP Pushbutton circuitry on Remote Control Console allows release of STOP control by inadvertent use of Selector Switch (see: 12.22.1 & 13.0).

2.2 Present proximity of RESET Pushbutton to EMERGENCY STOP Pushbutton could allow a loss of STOP action when needed (see: 12.22.2 & 13.0).

2.3 Additional Key Station is needed to protect maintenance crews and equipment from accidental actuation of mechanisms from Remote Control Console (see: 12.22.3 & 13.0).

3.0 BASIC CRITERIA

The human errors under consideration in this analysis have been those which could occur at any time while a man is performing as a systems component using the displays and control devices normally exposed to him. Any selector switch, pushbutton, key switch, pin connector plug or circuit breaker used in the operation or testing of the equipment is in this category and shall be considered as a potential cause of malfunction or disaster at any time while human beings are available to make mistakes. These human errors and various combinations thereof provide the basis for this analysis. Each error condition has been traced through the system either to a point where an interlock prevents actuation or through the actuation with a study of its implications.

4.0 SCOPE

We have considered here in this analysis those human error-control combinations which have even the remotest possibility of causing damage to equipment through collision of parts and overload conditions (electrical or mechanical). Every man-operated control, interlock and device which is normally available to be used, misused, misinterpreted or neglected has been listed in the ELIMINATION STUDY. Each control element has been checked off as eliminated for reasons stated, or continued for further analysis. Although maintenance procedures, the use of jumpers in junction boxes, chassis plug removal and replacement and other specialized situations have not been specifically considered in this effort, nevertheless the following items have been uncovered and are

important enough to mention here.

WARNING

1. Human error can contribute to situations leading to serious damage, unless safety precautions are carefully followed during maintenance operations (i.e. unless the logic voltage is OFF and all four test plugs are IN during removal and replacement of a function chassis - equipment could be moved out of sequence causing injury to personnel or damage to the Launcher and/or Missile. Replacement of a chassis should always be immediately followed by a complete checkout of all SIMULATED Tests and automatic recorrelation which is accomplished by removing the test plugs).

2. Launcher Tests (actual movement of hardware from Operating Test Panel) and operations from Local Control Stations should be initiated only while logic chassis, junction boxes and Motor Control power supplies are secured and checked out as operational.

3. Maintenance operations of any nature should only be performed with all Motor Control power OFF and locked at the circuit breakers.

4. Extension of Work Platforms and Umbilical Mechanisms during ABORT can only be accomplished locally or remotely if the LAUNCHER PLATFORM indicates DOWN.

5.0 TABLE OF CONTENTS

	<u>SECTION</u>
PURPOSE	1.0
ACTION ITEMS	2.0
BASIC CRITERIA	3.0
SCOPE	4.0
CONTENTS	5.0
ELIMINATION STUDY	6.0
INTERLOCKS	7.0
SIMULTANEOUS CONTROL ERRORS	8.0
CIRCUIT BREAKER ANALYSIS	9.0
TEST PLUG ANALYSIS	10.0
HUMAN ERRORS	11.0
ERROR ANALYSIS	12.0
TUNNEL ENTRANCE CONTROL STATION (T.E.C.S.)	.1
GROUND LEVEL PORTABLE CONTROL STATION (G.L.P.C.S.)	.2
CYCLING CONTROL STATION	.3
WORK PLATFORM LOCAL CONTROLS	.4
OPERATING TEST CONTROL PANEL AND TEST PLUGS (O.T.C.P.)	.5
TUNNEL ENTRANCE CONTROL STATION AND OPERATING TEST CONTROL PANEL	.6
TUNNEL ENTRANCE CONTROL STATION AND CYCLING CONTROL STATION	.7
TUNNEL ENTRANCE CONTROL STATION AND RETRACTION MECHANISMS	.8
TUNNEL ENTRANCE CONTROL STATION AND WORK PLATFORMS	.9
TUNNEL ENTRANCE CONTROL STATION AND TEST PLUGS	.10
TUNNEL ENTRANCE CONTROL STATION AND CIRCUIT BREAKERS	.11
OPERATING TEST CONTROL PANEL AND CYCLING CONTROL STATION	.12

OPERATING TEST CONTROL PANEL AND RETRACTION MECHANISMS	12.13
OPERATING TEST CONTROL PANEL AND WORK PLATFORMS	.14
OPERATING TEST CONTROL PANEL AND CIRCUIT BREAKERS	.15
GROUND LEVEL PORTABLE CONTROL STATION AND OPERATING TEST CONTROL PANEL	.16
GROUND LEVEL PORTABLE CONTROL STATION AND WORK PLATFORMS	.17
GROUND LEVEL PORTABLE CONTROL STATION AND RETRACTION MECHANISMS	.18
GROUND LEVEL PORTABLE CONTROL STATION AND CYCLING CONTROL STATION	.19
GROUND LEVEL PORTABLE CONTROL STATION AND CIRCUIT BREAKERS	.20
GROUND LEVEL PORTABLE CONTROL STATION AND TEST PLUGS	.21
REMOTE CONTROL CONSOLE AND LAUNCHER SYSTEM	.22
FIELD CHANGES	13.0

KEY C = Continued E = Eliminated	CONTINUED FOR ANALYSIS	ELIMINATE →	SPARE	SOFT CONSEQUENCE ONLY	ACTUATED ONLY AFTER LAUNCH COUNTERMANN INTERLOCK	TEST REQUIREMENT ONLY		
<u>TUNNEL ENTRANCE CONTROL STATION</u>								
<u>Launcher Platform</u>								
Launcher Platform Stop Pushbutton				E				
Launcher Platform Up Fast Pushbutton	C							
Launcher Platform Up Slow Pushbutton	C							
Launcher Platform Down Slow Pushbutton	C							
Launcher Platform Down Fast Pushbutton	C							
<u>Power Pack Partial</u>								
Power Pack Partial Off Pushbutton				E				
Power Pack Partial On Pushbutton				E				
<u>Power Pack Full</u>								
Power Pack Full Off Pushbutton	C							
Power Pack Full On Pushbutton	C							
<u>Silo Doors</u>								
Silo Doors Close Pushbutton	C							
Silo Doors Open Pushbutton	C							
<u>Crib Locks</u>								
Crib Locks Unlock Pushbutton	C							
Crib Locks Lock Pushbutton	C							
<u>Cable Slack</u>								
Cable Slack Slacken Pushbutton	C							
Cable Slack Tension Pushbutton	C							
<u>GROUND LEVEL PORTABLE CONTROL STATION</u>								
<u>Power Pack Full</u>								
Power Pack Full Off Pushbutton				E				
Power Pack Full On Pushbutton				E				
<u>Water Spray</u>								
Water Spray Off					E			
Water Spray Missile Protection on Pushbutton					E			
Water Spray Flame Deflector on Pushbutton					E			
<u>Launcher Platform</u>								
Launcher Platform Up Slow Pushbutton	C							
Launcher Platform Down Slow Pushbutton	C							
Launcher Platform Down Fast Pushbutton	C							
Launcher Platform Stop Pushbutton				E				
Launcher Platform Lock Pushbutton	C							
<u>G.L.P.C.S. Connection Box Cover Interlocks</u>	C							

KEY	CONTINUED FOR ANALYSIS	ESTIMATED ▲	SPACE	SAFE CONSEQUENCE ONLY	ACTUATED ONLY AFTER LAUNCH CONTROLLER INTERLOCK	TEST EQUIPMENT ONLY		
C = Continued E = Eliminated								
<u>CYCLING CONTROL STATION</u>								
<u>Annunciator Control Panel</u>						E		
<u>Accumulator Pump Run</u>						E		
<u>System 1</u>								
Super Charger #1 Pushbutton				E				
High Pressure #1 Pushbutton				E				
High Pressure #II Pushbutton				E				
<u>System 2</u>								
Super Charger II Pushbutton				E				
High Pressure II Pushbutton				E				
High Pressure III Pushbutton				E				
<u>Master Switch</u>								
Master Switch Local	C							
Master Switch Remote	C							
<u>WORK PLATFORM CONTROLS</u>								
<u>Work Platform #1 Key Switch</u>								
Work Platform #1 Extend Position	C							
Work Platform #1 Retract Position	C							
<u>Work Platform #2 Key Switch</u>								
Work Platform #2 Extend Position	C							
Work Platform #2 Retract Position	C							
<u>Work Platform #3 Key Switch</u>								
Work Platform #3 Extend Position	C							
Work Platform #3 Retract Position	C							
<u>Work Platform #4 Key Switch</u>								
Work Platform #4 Extend Position	C							
Work Platform #4 Retract Position	C							
<u>Work Platform #5 Key Switch</u>								
Work Platform #5 Extend Position	C							
Work Platform #5 Retract Position	C							
<u>RETRACTION MECHANISMS LOCAL CONTROLS</u>								
<u>1E1L Retraction Mechanism</u>								
1E1L Extend Pushbutton	C							
1E1L Retract Pushbutton	C							
<u>3B1L Retraction Mechanism</u>								
3B1L Extend Pushbutton	C							
3B1L Retract Pushbutton	C							

KEY C = Continued E = Eliminated	CONTINUED FOR ANALYSIS	ELIMINATED ▲	SPACE	SAFE CONSEQUENCES ONLY	ACTUATED ONLY AFTER LAUNCH CONTROLLER INTERLOCK	TEST EQUIPMENT ONLY			
<u>2B1LV Retraction Mechanism</u>									
2B1LV Extend Pushbutton	C								
2B1LV Retract Pushbutton	C								
<u>2B2LV Retraction Mechanism</u>									
2B2LV Extend Pushbutton	C								
2B2LV Retract Pushbutton	C								
<u>1C1LV Retraction Mechanism</u>									
1C1LV Extend Pushbutton	C								
1C1LV Retract Pushbutton	C								
<u>OPERATING TEST CONTROL PANEL</u>									
Launcher Status Pushbutton	C								
<u>Directory Switch 1 through 20</u>						E			
(LAUNCHER OPERATIONAL INFORMATION)									
Test Status Pushbutton						E			
<u>Key Switch</u>									
Key Switch Off (Simulated Tests Only)				E					
Key Switch On (Actual Launcher Test With Test Selector on #2)	C								
<u>Test Selector Switch</u>									
Off				E					
Launcher Test	C								
Normal Cycle				E					
Engine Spray				E					
Platform Up				E					
Doors Open				E					
Power Pack On				E					
Fault Program				E					
Extend Local Umbilicals				E					
"Shutdown" Reverse Pushbutton	C								
<u>TEST PLUGS</u>									
Test Plug #1	C								
Test Plug #2	C								
Test Plug #3	C								
Test Plug #4	C								
<u>CIRCUIT BREAKERS</u>									
CRO1 Mode Selection BUS A 4	C								

KEY	CONTINUED FOR ANALYSIS	ELIMINATED	SPARE	SAFS CONSEQUENCES ONLY	INTERLOCK	LAUNCH CONTROLLER	ACTUATED ONLY AFTER	TEST EQUIPMENT ONLY
CB02 Auto Programmer BUS A 1	C							
CB03 Forward Logic BUS B 1	C							
CB04 Reverse Logic BUS B 2 & (B 3)	C							
CB05 8.5.1 32 K11-1 Interlock BUS	C							
8.5.2 32 K11-2 L.S. Bypass BUS B 5								E
CB06 Spare			E					
CB07 Fault Circuitry BUS A 2				E				
CB08 Test Circuitry BUS A 5								E
CB09 Spare			E					
CB16 Spare			E					
CB17 Umbilicals, Water Spray, Tower Forward BUS C 5	C							
CB18 Shelter Door, Cable Launcher Platform Forward BUS C 4	C							
CB19 Crib Lock Forward, Water Spray, Tower Umbilicals, L/P Reverse BUS C 3	C							
CB20 Power Pack, Shelter Door Cable, Crib Lock - Reverse BUS C 2	C							
CB11 L/C Signal BUS 3VDC BUS C 1								E
CB12 3V Test Bus BUS D 1 (P1) (P2)								E
CB13 Spare			E					

7.0 INTERLOCKS

7.1.0 TUNNEL ENTRANCE CONTROL STATION

- 1.1 Before L/P can be moved up SLOW or FAST, the following conditions must be satisfied:

FUNCTION STATUS RELAYS OF THE FOLLOWING ITEMS MUST BE ENERGIZED (through contacts of limit switches mounted directly on the mechanisms):

- 1.1.1 SHELTER DOOR FULLY OPEN
- 1.1.2 CABLE TENSIONED
- 1.1.3 1E1L RETRACTED
- 1.1.4 3B1L RETRACTED
- 1.1.5 2B1LV RETRACTED
- 1.1.6 2B2LV RETRACTED
- 1.1.7 1C1LV RETRACTED
- 1.1.8 WORK PLATFORMS RETRACTED
- 1.1.9 EQUALIZER IN OPERATION
- 1.1.10 G.L.P.C.S. connection box cover must be closed

NOTE: Any change in any one of these conditions will immediately STOP the LAUNCHER PLATFORM (unless there is a function relay failure at the same time).

- 1.2 Before L/P can be moved DOWN, the following conditions must be satisfied:

FUNCTION STATUS RELAYS OF THE FOLLOWING ITEMS MUST BE ENERGIZED (through contacts of limit switches mounted directly on the mechanisms):

- 1.2.1 TOWER MECHANISM ERECT
- 1.2.2 WATER SPRAY VALVE CLOSE DRIVE MEMORY (OPEN) & WATER SPRAY VALVE CLOSE INDICATED.
- 1.2.3 G.L.P.C.S. connection box cover must be closed

7.2.0 WORK PLATFORM INTERLOCKS

- 2.1 Work platform cannot be extended while L/P is off the bottom.

7.3.0 UMBILICAL SUPPORT MECHANISM INTERLOCKS

- 3.1 Local retraction of these mechanisms can only be accomplished after the umbilicals have been manually disconnected from the missile.

7.4.0 CYCLING CONTROL STATION

The REMOTE-LOCAL switch accomplishes the following:

- 4.1 REMOTE: 1. TUNNEL ENTRANCE CONTROL STATION & GROUND LEVEL PORTABLE CONTROL STATION are capable of starting and stopping the Power Pack Pumps.
2. SYSTEM #1 and #2 control boxes are inoperative.
- 4.2 LOCAL: The reverse of above is true.

8.0 SIMULTANEOUS CONTROL ERRORS

8.1.0 Tunnel Entrance Control Station and Ground Level Portable Control Station

(Not possible because of interlocks within G.L.P.C.S. connection box - when box cover if open T.E.C.S. is disabled.)

8.2.0 Tunnel Entrance Control Station and Cycling Control Station

2.1 REMOTE-LOCAL switch in REMOTE position.

SYSTEM #1 and SYSTEM #2 controls are inoperative
Power Pack control is exclusively with T.E.C.S.

2.2 REMOTE-LOCAL switch in LOCAL position.

T.E.C.S. is inoperative - SYSTEM #1 and #2
boxes have control of Power Pack.

8.3.0 Tunnel Entrance Control Station and Operating Test Control Panel

There is very little chance that simultaneous control between Tunnel Entrance Control Station and Operating Test Control Panel can occur if equipment is already in motion controlled by Tunnel Entrance Control Station. The following conditions must be met before this can happen:

3.1 The operator at O.T.C.P. must insert Test Plug #1 against the RED plug status display.

3.2 The Key Switch must be turned to the ON position. (TEST MODE display indicates RED - LAUNCHER)

3.3 The Test Selector Switch must be at #2 LAUNCHER TEST position.

3.4 TEST STATUS display will indicate RED NO-GO.

3.5 LAUNCHER STATUS display will indicate RED NON-OPERATIONAL.

3.6 Umbilicals must be retracted before the Launcher Platform can be started upward from any station. The SUMMED INTER-LOCK UMBILICAL RETRACTION ALLOWED closure must be accomplished in the LAUNCH CONTROLLER before any mechanism can be actuated in automatic or from the Operating Test Control Panel in a test. An umbilical coupling must be manually disconnected before the related mechanism can be retracted by using a local control pushbutton station.

9.0 CIRCUIT BREAKER AND BUS ANALYSIS

9.1.0 PURPOSE: TO DETERMINE THE EFFECT AN OPEN D.C. CIRCUIT BREAKER WOULD HAVE UPON THE LOGIC SYSTEM AND THE LAUNCHER MISSION.

9.2.0 SUMMARY

2.1 31 CBO3 (B1-FORWARD LOGIC)

If 31 CBO3 is opened, it will not be possible to drive the shelter doors open (12K09) or to raise the platform (12K19).

2.2 31 CBO4 (B2, B3-REVERSE LOGIC)

If 31 CBO4 is opened, it will not be possible either to lower the platform (12K15) or to drive the shelter doors closed (12K04).

2.3 31 CBO5 (B4, B5-INTERLOCK BUS)

If 31 CBO5 is opened, it will not be possible to energize the relays that indicate the platform is up (12K20), the platform is down (12K16), the doors are open (12K10), and the doors are closed (12K06). As a result it will not be possible to raise the platform.

2.4 31 CB18 (C4)

If 31 CB18 is opened, it will not be possible to energize the solenoids to drive the shelter doors open (10A3ALL51-14 10A3ALL50-1) or to raise the platform (10A3ALL55-1).

2.5 31 CB19 (C3)

If 31 CB19 is opened, it will not be possible to energize the solenoid to lower the platform.

2.6 31 CB20 (C2)

Power pack shuts off.

If 31 CB20 is opened, it will not be possible to drive the shelter doors closed (10A3ALL50-2 & 10A3ALL51-2).

9.3.0 ANALYSIS

These Circuit Breakers are located on C.B. Chassis SALA1 in the Logic Racks.

3.1 CBO1 MODE SELECTION BUS (A4) 26VDC constant

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. Catastrophic failure indication removal

9.2.0 (Continued)

of Forward and Reverse Logic voltage.

2. Change over from 26VDC to 3VDC on Actuator Buses C2, C3, C4, and C5.
3. Power Supply Contactors - supply to Actuator Buses C2, C3, C4, and C5.
4. All Status and Directory indications.

(16K01, 16K07 and 16K16 will be deenergized)
(all Plug Status indications will be out)

3.2 CBO2 AUTO PROGRAMMER BUS (A1) 26VDC constant

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. 26VDC distribution to COMMAND BUS (B6) or TEST CONTROLLER BUS (B7).
2. All Signal Receiver and Repeater functions.
(No commands received from L.C. or repeated into the Launcher Controller System)

3.3 CBO3 FORWARD LOGIC BUS (B1) 26VDC constant

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. All distribution to Command Memory Relays and Drive Memory Relays in the FORWARD zone.

ENGINE COMPARTMENT	CLOSE
CRIB LOCKS	LOCK
FLAME DEFLECTOR VALVE	CLOSE
MAIN WATER SUPPLY VALVE	OPEN
SILO DOORS	OPEN
CABLE SYSTEM	TENSION
LAUNCHER PLATFORM	RAISE AND LOCK
1E1L SUPPORT MECH.	RETRACT
3B1L SUPPORT MECH.	RETRACT
2B1LV	RETRACT
2B2LV	RETRACT
1C1LV	RETRACT
TOWER MECHANISM	ENERGIZED

3.4 CBO4 REVERSE LOGIC (B2) 26VDC constant

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. All distribution to Command Memory Relays and Drive Memory Relays in the REVERSE zone.

ENGINE COMPARTMENT VALVE	OPEN
CRIB LOCKS	UNLOCK
FLAME DEFLECTOR VALVE	CLOSE

MAIN WATER SUPPLY VALVE	CLOSE
SILO DOORS	CLOSE
CABLE SYSTEM	SLACKEN
LAUNCHER PLATFORM	UNLOCK AND LOWER
1E1LV SUPPORT MECH.	(LOCAL) EXTEND
3B1LV SUPPORT MECH.	(LOCAL) EXTEND
2B1LV SUPPORT MECH.	(REMOTE) EXTEND
2B2LV SUPPORT MECH.	(REMOTE) EXTEND
1C1LV SUPPORT MECH.	(REMOTE) EXTEND
TOWER MECHANISM	ERECT

CB04 NO LOGIC VOLTAGE (B3) 26VDC with
32K13-2 closed

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. Indication to the Test Controller.
2. Correlation circuitry.

3.5 CB05 INTERLOCK BUS (B4) 26VDC constant

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. All Limit Switch Closures will read open.
2. All Function Relays will open.
3. Power Pack ON displays will go out while pumps continue to run.

CB05 LIMIT SWITCH BYPASS used in test only

3.6 CB06 SPARE

3.7 CB07 FAULT CIRCUITRY BUS (A2) 26VDC constant

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1. All Fault Detection and Registration - no record of fault will appear.

3.8 CB08 TEST CIRCUITRY (A5) 26VDC constant

3.9 CB09 SPARE

3.10 CB10 WORK PLATFORM (A3) 26VDC constant

3.11 CB11 L/C SIGNAL BUS (C1) 3VDC constant

3.12 CB12 3VDC TEST BUS (D4) 3VDC constant

3.13 CB13 SPARE

3.14 CB16 SPARE

9.2.0 (Continued)

3.15 CB17 ACTUATOR BUS BUS (C5)

Changes from 26VDC to 3VDC with Test Plug #2, #3,
or #4 inserted.

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

1E1L SUPPORT MECH. SOLENOID	RETRACT
3B1L SUPPORT MECH. SOLENOID	RETRACT
2B1LV SUPPORT MECH. SOLENOID	RETRACT
2B2LV SUPPORT MECH. SOLENOID	RETRACT
1C1LV SUPPORT MECH. SOLENOID	RETRACT
ENGINE COMPARTMENT SPRAY VALVE SOLENOID	CLOSE
ENGINE COMPARTMENT BYPASS SOLENOID	SHUT OFF
FLAME DEFLECTOR SPRAY VALVE SOLENOID	CLOSE
MAIN WATER SUPPLY VALVE SOLENOID	OPEN
TOWER TILT SUPPLY VALVE SOLENOID	OPEN

3.16 CB18 ACTUATOR BUS BUS (C4)

Changes from 26VDC to 3VDC with Test Plug #2, #3,
or #4 inserted.

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

CABLE SYSTEM	LAUNCHER PLATFORM SOLENOIDS	UP
	UPPER AND LOWER DOOR SOLENOIDS	OPEN
	TENSION EQUALIZERS	ISOLATE
	DRIVE BASE TO SILO WALL REAR LOCKS	INSERT
	STUB RAIL LATCHES	EXTEND
	DRIVE BASE TO DOOR FOUNDATION SPRING LOCKS	RETRACT
	TENSION EQUALIZERS	RAISE
	COUNTERWEIGHT LIFTING CYLINDER	RAISE
	COUNTERWEIGHT TO DRIVE BASE LOCKS	RETRACT

3.17 CB19 ACTUATOR BUS BUS (C3)

Changes from 26VDC to 3VDC with Test Plug #2, #3,
or #4 inserted.

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

VERTICAL CRIB LOCKS SOLENOID	RAISE
HORIZONTAL CRIB LOCKS SOLENOID	EXTEND
INCLINED LOCKS SOLENOID	EXTEND
ENGINE COMPARTMENT SPRAY VALVE SOLENOID	OPEN
FLAME DEFLECTOR SPRAY VALVE SOLENOID	OPEN

9.2.0 (Continued)

MAIN WATER SUPPLY VALVE	
SOLENOID	CLOSE
TOWER TILT SOLENOID	ERECT
1ELL SUPPORT MECH. SOLENOID	(LOCAL) EXTEND
3BLL SUPPORT MECH. SOLENOID	(LOCAL) EXTEND
2BLLV SUPPORT MECH. SOLENOID	(REMOVE) EXTEND
2B2LV SUPPORT MECH. SOLENOID	(REMOVE) EXTEND
1CLLV SUPPORT MECH. SOLENOID	(REMOVE) EXTEND
LAUNCHER PLATFORM SOLENOIDS	DOWN

3.18 CB20 ACTUATOR BUS BUS (C2)

Changes from 26VDC to 3VDC with Test Plug #2, #3,
of #4 inserted.

REMOVAL OF BUS VOLTAGE WILL NEGATE THE FOLLOWING:

	VERTICAL CRIB LOCKS SOLENOID	LOWER
	HORIZONTAL CRIB LOCKS SOLENOID	RETRACT
	INCLINED LOCKS SOLENOIDS	RETRACT
	POWER PACK	FULL & PARTIAL CONTROL
	UPPER & LOWER DOOR SOLENOIDS	CLOSE
	COUNTERWEIGHT TO DRIVE BASE LOCKS	EXTEND
	TENSION EQUALIZERS	LOWER & FILL MEASURING VESSEL
CABLE SYSTEM	DRIVE BASE TO DOOR FOUNDATION SPRING LOCKS	INSERT
	STUB RAIL LATCHES	RETRACT
	DRIVE BASE TO SILO WALL REAR LOCKS	RETRACT
	COUNTERWEIGHT LIFTING CYLINDER	RAISE

10.0 TEST PLUG ANALYSES

10.1 ANALYSIS OF TEST PLUG REMOVAL DURING LAUNCHER PLATFORM TEST INITIATED AT THE OPERATING TEST CONTROL PANEL

1.1 Providing there is no failure during the procedure, the Launcher Platform will be driven to its full up and locked position and returned to its fully lowered position when the Test Selector Switch on the Operating Test Control Panel is set at position 2, the key switch is ON, and Test Plug #1 only is inserted. At the start of this test, a signal is sent to the control circuitry from Deck 1 of the Test Program Stepping Switch 34K10. At the completion of the first operation in the sequence, a signal is returned from the control circuitry to Deck 2 of 34K10. This signal is transmitted by the Program Status Indication Relay 45K03 to the coil of the Test Signal Receiver Relay 37K34. Relay 37K34 energizes relay 34K06 which allows the coil of the Test Program Stepping Switch to be energized. As a result 34K10 steps to its next position and another signal is sent from Deck 1 to initiate the next operation in the sequence. This procedure continues until 34K10 has advanced through its 24 positions and returned to HOME. At this time the Launcher Platform will be restored to its fully down position.

1.2 If an operator inadvertently removes Test Plug #1 during any part of this test, 45K03 will be deenergized. As a result, it will not be possible to energize the Test Program Stepping Switch and 34K10 will remain where it is. The operation in process at the time will be completed. (For example if 34K10 is at position 6 when Test Plug #1 is disconnected, the Launcher Platform will move until a fully up and locked indication is transmitted to the control circuitry.

10.1.2 (Continued)

During the period Test Plug #1 is unplugged, 34K10 will remain where it is unless it has been returned to the HOME position by actuation of the Test Status Pushbutton. This pushbutton energizes the Program Bypass Memory Relay 45K11-1 which causes Relay 34K10 to be stepped until it returns to HOME.

1.3 The Launcher Test can be completed when Test Plug #1 is reconnected provided that the Test Selector Switch has not been moved from position 2. If 34K10 is at HOME, it will be necessary for the operator to push the Test Start Pushbutton. This will cause 34K10 to advance through its 24 positions and complete the sequence. If 34K10 is at its previous position, it will continue from that point and complete the sequence.

10.2 TEST PLUG STATUS LIGHTS

An operator is provided with visual cues which constantly guide him in the proper handling of the four test plugs. The equipment which provides these cues is described below.

2.1 One transilluminated indicator has been located directly above each Test Plug on the Connector Chassis.

A RED and a GREEN status light indication is provided for each of the four test plugs. One of the two lights associated with each plug will always be illuminated, while Circuit Breaker CB01 is closed and Bus A4 is energized. A GREEN light means that the plug may be connected or disconnected while a RED light means that the plug should not be touched.

2.2 The RED lights will all be illuminated:

2.2.1 While (Partial Power Pack On) Relay 33K10 is energized (Power Pack Pumps running in any mode of operation).

2.2.2 Or while 33K10 (Partial Power Pack On) is not energized; 45K06 (Test Controller Connected) is energized; 45K12 (Fault Program Repeat) is not energized; and 45K03 (Program (Test) Start) is energized in any test mode originated from the Operating Test Control Panel.

2.3 The GREEN light will be illuminated over plug #1 while relay 33K10 is deenergized. When plug #1 is connected, the (Test Controller Connected) Relay 45K06 will be energized causing the GREEN light to be illuminated over plug #2. When pins 93 and 94 of plug #2 make contact and the 32K10 (26VDC Contactor On) Relay is not energized the GREEN lights over plugs #3 and #4 will be illuminated. At the same time, the display over plug #1 will change from GREEN to RED.

10.3 TEST PLUG PIN ANALYSIS (REFERENCE HFT-1035) available from Human Factors Group, Technical Staff, GED, 11 Bruce Place, Greenwich, Connecticut.

3.1 If the Power Pack is ON and Test Plug #1 is inserted.

(33K10 Partial Power Pack ON contacts open)

1. IC signal bus will not switch to 3VDC.
2. B6 command bus will remain alive.
3. B7 Test Controller bus will be dead.

3.2 If the Power Pack is ON and Test Plug #2, #3, or #4 are connected.

1. Actuating supply buses will remain at 26VDC.
2. 45K01 (Test Controller connected) will be energized.
3. (#2) 42S04 Key Switch (Launcher Test) is bypassed.

4. A closure of any Drive Memory Relay will burn out the associated 3VDC Actuator Sensing Relay and short out the associated solenoid. If the solenoid burns open, actuation may continue if the circuit breakers hold on the actuation buses. It is very likely that during Launcher Platform movement the effect of such an error would result in a Power Pack shutdown which will cause the Launcher Platform brake to stop the platform motion safely.

11.0 HUMAN ERRORS

Various types and causes of human errors have been categorized for use on ERROR ANALYSIS SHEETS. Letter designations are referenced in the ERROR columns of the ANALYSIS SHEETS within section 12.0.

11.1 ERRORS

1.1 INVOLVING SINGLE LOCATION:

- A. Accidental actuation.
- B. Out of sequence operation (disregarding illuminated display clues or direct visual clues).

1.2 INVOLVING VARIOUS LOCATIONS:

- C. Conflicting actuations.
- D. Loss of control.

11.2 CAUSES

2.1 INCORRECT PROCEDURES

- E. Failure to use lamp test to determine capability of illuminated displays.
- F. Failure to clear with proper authority before changing equipment condition.
- G. Failure to follow safety precautions.
- H. Inadquate knowledge of the system.

2.2 INADVERTENT ACTIONS

- I. Leaning against controls (recessed buttons).
- J. Actuation while cleaning controls.
- K. Mistakes (negligence).
- L. Panic.

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE	CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.1.0 TUNNEL ENTRANCE CONTROL STATION						
12.1.1	FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P UP FAST (IN MOTION)	A	L	FULL POWER PACK ON RELAY (33K12) OPENS AND PLATFORM STOPS	NONE	LAUNCHER PLATFORM BRAKE IS APPLIED SAFE CONDITION
12.1.1.1 POWER PACK FULL OFF		A	K	SHELTER DOORS CANNOT BE CLOSED UNTIL L/P FULLY LOWERED RELAY (12K16) IS ENERGIZED	RELAY (12K10) (SHELTER DOORS FULLY OPEN) WILL ENERGIZE THE CATASTROPHIC FAILURE RELAY (35K02) IF DOORS START TO CLOSE	SAFE
12.1.1.2 SILO DOORS CLOSE		A	K	CABLE SLACK INDICATION RELAY (12K11) MUST BE ENERGIZED. THIS REQUIRES THAT L/P FULLY LOWERED RELAY (12K16) BE ENERGIZED	NONE	SAFE
12.1.1.3 CRIB LOCKS UNLOCK		A	K	L/P FULLY LOWERED RELAY (12K16) MUST BE ENERGIZED	CABLE TENSION RELAY (12K17) WILL DEENERGIZE AND STOP THE MOVEMENT OF THE PLATFORM	SAFE
12.1.1.4 PLATFORM CABLE SLACKEN		A	K			
12.1.2	FULL POWER PACK ON SILO DOORS OPENING (IN MOTION)	A	K			WITH THE POWER PACK OFF THE OPERATOR WILL NOT BE ABLE TO CONTROL THE POSITION OF THE DOORS. IF THE DOORS ARE AT AN ANGLE OF MORE THAN 90°, THEY WILL REMAIN OPEN. IF THE DOORS ARE AT AN ANGLE OF LESS THAN 90°, THEY WILL CLOSE SLOWLY DUE TO LEAKAGE IN THE HYDRAULIC SYSTEM.
12.1.2.1 POWER PACK FULL OFF		A	K	NONE	NONE	

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR		FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
		TYPE	CAUSE			
12.1.3	FULL POWER PACK ON CRIB LOCKS LOCKED PL. CABLE TENSIONED SILO DOORS CLOSED	B	K	SHELTER DOORS FULLY OPEN RELAY (12K10) CONTACT (08) MUST BE ENERGIZED FOR PLATFORM MOVEMENT	RELAY (12K10) CONTACT (H15) WILL ENERGIZE THE CATASTROPHIC FAILURE RELAY (35K02) IF LAUNCHER STARTS UP OFF THE BOTTOM	SAFE CONDITION
12.1.3.1 LAUNCHER PLATFORM UP FAST				SAFE		SAFE - HOWEVER, THE CONTROL IS A MOMENTARY PUSHBUTTON WITH SPRING RETURN TO A "STOP" CONDITION. IF THE OPERATOR OBSERVES HIS ERROR BEFORE THE CATASTROPHIC FAILURE CIRCUITRY IS ENERGIZED, HE CAN RELEASE THE CONTROL, WHICH STOPS THE MOTION AND PREVENTS CATASTROPHIC POWER SHUT OFF
12.1.3.2 LAUNCHER PLATFORM UP SLOW	SAFE	A	H	SAFE		

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.1.4	FULL POWER PACK ON CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P DOWN SILO DOORS CLOSING (IN MOTION)	A	NONE	NONE	WITH THE POWER PACK OFF THE OPERATOR WILL HAVE NO CONTROL OF THE DOORS. IF THE DOORS ARE AT AN ANGLE OF MORE THAN 90°, THEY WILL REMAIN OPEN. IF THE DOORS ARE AT AN ANGLE OF LESS THAN 90°, THEY WILL CLOSE SLOWLY DUE TO LEAKAGE IN THE HYDRAULIC SYSTEM.
12.1.4.1 FULL POWER PACK OFF		K			
12.2.0 GROUND LEVEL PORTABLE CONTROL STATION	CONNECTION BOX OPEN CABLE PLUG CONNECTED FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKED PL. CABLE TENSIONED L/P DOWN FAST (IN MOTION)	A	THE L/P RAISE AND LOCK COMMAND MEMORY RELAY (12K14-2) IS DEENERGIZED AT THIS TIME.	THE LOAD LOCKS SOLENOID (E497) CANNOT BE ENERGIZED UNLESS ONE OF THE FOUR PLATFORM UP SWITCHES (E 440, 441, 442, 443) IS CLOSED.	LAUNCHER PLATFORM BEARS IS APPLIED.
12.2.1		L			
12.2.1.1 LAUNCHER PLATFORM LOCK		K	CONTACT FL2 OF RELAY (33K12) WILL OPEN AND DEENERGIZE THE L/P LOWER DRIVE MEMORY RELAY (12K 15).	NONE	
12.2.1.2 POWER PACK OFF		A			

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR		FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
		TYPE	CAUSE			
12.3.0 <u>CYCLING CONTROL STATION</u>						
12.3.1	ALL PUMPS RUNNING FROM SYSTEM #1 & II CONTROL BOXES MAIN MOTORIZED VALVE CLOSED BY PASS MOTORIZED VALVE OPENED MASTER SWITCH AT LOCAL	A	H	NONE	NONE	POWER PACK WILL SHUT-OFF MAIN VALVE WILL OPEN & BY PASS VALVE WILL CLOSE
12.3.1.1 MASTER SWITCH CHANGED TO REMOTE						
12.4.0 <u>WORK PLATFORM LOCAL CONTROLS</u>						
12.4.1	WORK PL #2 EXTENDED CREW WORKING ON #2	A	G	FOR WPL #1 TO BE EXTENDED, THE WPL #2 MAIN MECHANISMS RETRACTED SWITCHES (CL15, L16, L17, L18) MUST BE CLOSED.		CREW IS SAFE (ONE DOWN FOLDING LEAF OF WPL #1 PASSES THROUGH WPL #2 WORK SPACE)
12.4.1.1 WORK PLATFORM #1 EXTEND						
12.4.2	WORK PL #1 EXTENDED WORK PL #2 EXTENDED CREW WORKING ON #2	A	G	FOR WPL #1 TO BE RETRACTED, SWITCHES (CL15, L16, L17, AND L18) MUST BE CLOSED.		CREW IS SAFE (ONE DOWN FOLDING LEAF OF WPL #1 PASSES THROUGH WPL #2 WORK SPACE)
12.4.2.1 WORK PLATFORM #1 RETRACT						

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.5.0 OPERATING TEST CONTROL PANEL & TEST PLUGS					
12.5.1	16K17 RETRACT SUPPORT MECH. SUMMED INTER-LOCK RECEIVED ON KEY SWITCH SELECTOR SWITCH AT #2 LAUNCHER TEST LAUNCHER STATUS DISPLAY RED CAUSE: WORK PLATFORMS NOT RETRACTED TEST PLUG # 1 IN	B	THE WORK PLATFORMS RETRACTED RELAY 16K16 MUST BE ENERGIZED SO THAT CONTACT BA IS CLOSED AND THE LAUNCHER OPERATIONAL RELAY (16K07) IS ENERGIZED.	(16K16) MUST BE ENERGIZED SO THAT CONTACT (F11) IS OPEN AND THE CATASTROPHIC FAILURE RELAY 35K 02 IS NOT ENERGIZED.	
12.5.1.1 START TEST PUSHBUTTON					
12.5.2	16K17 RETRACT SUPPORT MECH. SUMMED INTER-LOCK RECEIVED ON KEY SWITCH SELECTOR SWITCH AT #2 LAUNCHER TEST LAUNCHER PLATFORM MOVING UP IN TEST PLUG STATUS INDICATORS RED	B	THE PROGRAM STATUS INDICATION RELAY (45K03) WILL BE DEENERGIZED. DURING TEST THIS RELAY TRANSMITS AN OPERATION COMPLETS SIGNAL FROM DECK 2 OF THE TEST STEPPING SWITCH (34K10) TO THE COIL OF THE TEST SIGNAL RECEIVER RELAY (34K06) WHICH ALLOWS (35K10) TO BE ADVANCED TO ITS NEXT POSITION. WITH TEST PLUG #1 REMOVED (34K10) WILL REMAIN AT ITS PRESENT POSITION.	NONE	THE LAUNCHER PLATFORM WILL CONTINUE TO MOVE UNTIL A FULLY UP AND LOCKED INDICATION IS SENT TO THE CONTROL CIRCUITRY. AT THIS TIME ALL ACTION WILL STOP.
12.5.2.1 TEST PLUG #1 UNPLUG					

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.5.2.2 TEST PLUG #1	REFUG	A L	NONE	NONE	IF THE SELECTOR SWITCH HAS NOT BEEN ADVANCED, (34410) WILL STEP TO ITS NEXT POSITION AND THE LAUNCHER PLATFORM WILL BE LOWERED UNTIL A FULLY LOWERED INDICATION IS SENT TO THE CONTROL CIRCUITRY.
12.5.3	SAME AS ABOVE L/P IN MOTION UP				
12.5.3.1 TEST PLUG #2	PLUG IN	B F	NONE	NONE	NO EFFECT
12.5.3.2 TEST PLUG #3	PLUG IN	B F	NONE	NONE	NO EFFECT
12.5.3.3 TEST PLUG #4	PLUG IN	B F	NONE	NONE	WITH J/FOU CONNECTED AND THE PARTIAL POWER PACK RELAY (34410) ENERGIZED THERE WILL BE 26V ON THE CL BUS. THE JV POWER PACK SIMULATOR RELAY (37 K33-1) WILL BE ENERGIZED BY 26V AND SHORT CIRCUIT THE POWER PACK STARTING RELAY (17419). THE JV L/P UP SIMULATOR RELAY (37 K33-1) WILL BE ENERGIZED BY 26V AND SHORT CIRCUIT THE DRIVE SOLENOID. THE POWER PACK WILL SET OFF AND THE PLATFORM WILL STOP
12.5.4	TEST IN "SHUT DOWN" PLUG STATUS INDICATOR RED L/P IN MOTION DOWN				

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.5.4.1 TEST PLUG #1	UNPLUG	B	COMPLETION OF "UP" SEQUENCES WITH 3K10 STEPPER AT POINT 9 OF DECK 6		(3K10) WILL CONTINUE TO STEP TO HOME AND THE LAUNCHER SYSTEM WILL RETURN TO SHUT DOWN
		G	OR OPERATION OF (42507) (SHUTDOWN PUSHBUTTON) WILL ENERGIZE THE PROGRAM BY-PASS MEMORY SET RELAY (45K11-1). THIS RELAY WILL REMAIN LATCHED WHETHER TEST PLUG #1 IS CONNECTED OR NOT UNTIL STEPPING SWITCH (3K10) IS DRIVEN TO THE HOME POSITION. AT THIS POINT THE L/P WILL BE RETURNED TO ITS FULLY LOWERED POSITION.		
12.5.4.2 TEST PLUG #1	REPLUG	A	NONE	NONE	PLUG STATUS LIGHT SHOULD BE GREEN ALLOWING PLUG CONNECTION
12.5.5	SAME AS ABOVE L/P IN MOTION DOWN				
12.5.5.1 TEST PLUG #2	PLUG IN	B	NONE	NONE	NO EFFECT
12.5.5.2 TEST PLUG #3	PLUG IN	B	NONE	NONE	NO EFFECT
12.5.5.3 TEST PLUG #4	PLUG IN	B			26 VDC WILL BE APPLIED TO 3 VDC RELAYS (37K33-1) AND (37 K08-1) AS DESCRIBED IN 12.5.3 ABOVE

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.6.0 TUNNEL ENTRANCE CONTROL STATION & OPERATING TEST CONTROL STATION	L/P RUNNING UP ACTION INITIATED AT OPERATING TEST CONTROL STATION	C	CONTACTS (F12) OF RELAY (17K07) POWER PACK PUMP CONTROL LAUNCHER OPERATIONAL WILL BE CLOSED IN AN AUTOMATIC MODE THEREFORE THE LOCAL PUSHBUTTONS WILL HAVE NO EFFECT UPON THE SYSTEM.	NONE	THE POWER PACK WILL CONTINUE TO RUN AND THE OPERATION OF THE LAUNCHER SYSTEM WILL NOT BE AFFECTED.
12.6.1					
AT TUNNEL ENTRANCE CONTROL STATION					
12.6.1.1 POWER PACK FULL OFF					
12.6.1.2 SILO DOORS CLOSE		C	CONTACTS (C6) OF RELAY (12K16) L/P FULLY LOWERED IND. WILL BE OPEN IN THE DOOR CLOSING CIRCUIT.	IF THE DOORS SHOULD START TO CLOSE THE (H15) CONTACTS OF RELAY (12K10) SHELTER DOOR FULLY OPEN IND. WILL CLOSE IN THE CATASTROPHIC CIRCUIT CAUSING A NO-GO, A POWER SHUTOFF, AND A COMMAND TO SHUTDOWN.	SAFE CONDITION
12.6.1.3 CRIB LOCKS UNLOCK		C	CONTACTS (C6) OF RELAY (12K11) CABLE SLACK IND. WILL BE OPEN IN THE CRIB LOCKS UNLOCK CIRCUIT.	NONE	CRIB LOCKS WILL NOT UNLOCK
12.6.1.4 PLATFORM CABLE SLACKEN		C	CONTACTS (D8) OF RELAY (12K16) L/P FULLY LOWERED IND. WILL BE OPEN IN THE CABLE SLACKEN CIRCUIT	CONTACTS (C6) OF RELAY (12K17) CABLE TENSIONED IND. WILL OPEN AND STOP THE LAUNCHER PLATFORM MOTION	PLATFORM CABLE WILL NOT SLACKEN

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.7.0 <u>TUNNEL ENTRANCE CONTROL STATION AND CYCLING CONTROL STATION</u>	OPERATED FROM T.E.C.S. FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P UP FAST (IN MOTION)	D	NONE	NONE	POWER PACK PUMPS STOP. DRIVE SYSTEM BEAKE STOPS L/P IMMEDIATELY
12.7.1					
AT CYCLING CONTROL STATION					
12.7.1.1 MASTER SWITCH LOCAL					
AT SYSTEM #1 CONTROL BOX					
12.7.1.2 SUPER CHARGER #1 ON	OPERATED FROM T.E.C.S. FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P DOWN FAST (IN MOTION)	C	NONE	NONE	PUMPS WILL START. HOWEVER WITH MAIN MOTORIZED VALVE CLOSED & BY PASS VALVE OPEN NO FLUID CAN PASS TO LAUNCHER
12.7.1.3 HIGH PRESSURE #1 ON					
12.7.1.4 HIGH PRESSURE #2 ON					
12.7.2					
AT CYCLING CONTROL STATION					
12.7.2.1 MASTER SWITCH LOCAL					

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.8.0 <u>TUNNEL ENTRANCE CONTROL STATION AND RETRACTION MECHANISMS</u>					
12.8.1	OPERATED FROM T.E.C.S. FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P UP FAST (IN MOTION) OR L/P DOWN FAST (IN MOTION)				
AT RETRACTION MECHANISM LOCAL CONTROL STATION					
12.8.1.1 1E1L	EXTEND				
12.8.1.2 3B1L	EXTEND				
12.8.1.3 2B1LV	EXTEND				
12.8.1.4 2B2LV	EXTEND				
12.8.1.5 1C1LV	EXTEND				
12.9.0 <u>TUNNEL ENTRANCE CONTROL STATION AND WORK PLATFORMS</u>					
12.9.1	OPERATED FROM T.E.C.S. FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P UP FAST (IN MOTION) OR L/P DOWN FAST (IN MOTION)				

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
<u>AT WORK PLATFORM LOCAL CONTROL KEY STATION</u>					
12.9.1.1 WORK PLATFORM #1 EXTEND		C	LIMIT SWITCHES (E115, 1116, 1117 AND 1118) ARE OPEN UNLESS THE PLATFORM IS DOWN AND AS A RESULT THE WP OPERATE RELAY (32K09) WILL BE DEENERGIZED	CONTACT (F11) OF (16K16) (WP RETRACTED) WILL CLOSE AND ENERGIZE THE CATASTROPHIC FAILURE RELAY (35K02)	SAFE CONDITION
12.9.1.2 WORK PLATFORM #2 EXTEND					
12.9.1.3 WORK PLATFORM #3 EXTEND					
12.9.1.4 WORK PLATFORM #4 EXTEND					
12.9.1.5 WORK PLATFORM #5 EXTEND					
12.10.0 TUNNEL ENTRANCE CONTROL STATION AND TEST PLUGS	OPERATED FROM T.E.C.S. FULL POWER PACK ON SILO DOORS OPEN CRIB LOCKS LOCKED PL. CABLE TENSIONED L/P UP FAST OR DOWN FAST (IN MOTION) #1 PLUG STATUS RED & LAUNCHER STATUS RED	C	TEST START PUSHBUTTON 12506 MUST BE OPERATED TO INITIATE ANY ACTION FROM OPERATING TEST CONTROL PANEL	KEY SWITCH 12504 MUST BE TURNED TO THE ON OR LAUNCHER POSITION TEST SELECTOR 12503 MUST BE AT #2 POSITION	L/P CONTINUES UP. NO CATASTROPHE CAN BE CAUSED, HOWEVER THE (37K32-1) CO-RECEIVER RELAY WHICH IS RATED 3VDC WILL BE SUBJECTED TO 26VDC AND WILL PROBABLY BURN OUT. NO EFFECT
12.10.1.1 TEST PLUG #1 PLUG IN					
12.10.1.2 TEST PLUG #1 UNPLUG					
12.10.2.0					
12.10.2.1 TEST PLUG #2 PLUG IN					

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.10.2.2 TEST PLUG #3 PLUG IN		C G	NONE	NONE	NO EFFECT SAME AS 12.5.3.3
12.10.2.3 TEST PLUG #4 PLUG IN		C G			
12.11.0 TUNNEL ENTRANCE CONTROL STATION AND CIRCUIT BREAKERS					
12.11.1	OPERATED FROM T.E.C.S. FULL POWER PACK ON STALO DOORS OPEN CHIB LOCKS LOCKED PL. CABLE TENSIONED L/P UP OR DOWN FAST (IN MOTION)				
12.11.1.1 CB01 (A1) BUS OPEN		D F/J	26VDC CONTACTOR AL7ALK8 WILL OPEN. FORWARD LOGIC ACTUATION VOLTAGE WILL BE DEAD. L/P SOLENOID WILL DEENERGIZE.	NONE	L/P WILL STOP POWER PACK WILL STOP
12.11.1.2 CB01 (A1) BUS CLOSE		C L	SAME AS ABOVE	SAME AS ABOVE	POWER PACK WILL START ACTION WILL CONTINUE FROM POINT OF STOPPAGE L/P UP MOTION WILL STOP
12.11.1.3 CB03 (B1) BUS OPEN		D F/J	FORWARD LOGIC WILL BE OFF AND L/P UP DRIVE MEMORY RELAY WILL OPEN	NONE	
12.11.1.4 CB03 (B1) BUS CLOSE		C L	SAME AS ABOVE	SAME AS ABOVE	ACTION WILL CONTINUE FROM POINT OF STOPPAGE L/P DOWN MOTION WILL STOP
12.11.1.5 CB04 (B2) & (B3) OPEN		D F/J	REVERSE LOGIC WILL BE OFF AND L/P DOWN DRIVE WILL BE OPEN	SAME AS ABOVE	
12.11.1.6 CB04 (B2) & (B3) CLOSE		C L	SAME AS ABOVE	SAME AS ABOVE	ACTION WILL CONTINUE FROM POINT OF STOPPAGE

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.11.1.7 CB05 (B4)	OPEN	D	ALL INDICATING RELAY CONTACTS WILL RETURN TO NORMAL CONDITION. INTERLOCKING CONTACTS IN L/P DRIVE CONTROL CIRCUIT WILL OPEN. CATASTROPHIC CIRCUIT WILL BE ENERGIZED.		L/P WILL STOP FORWARD AND REVERSE VOLTAGE WILL BE OFF
12.11.1.8 CB05 (B4)	CLOSE	C	NONE		ACTION WILL CONTINUE AT POINT OF STOPPAGE
12.11.1.9 CB13 (C4)	OPEN	D	FORWARD ACTUATOR BUS C4 WILL BE DEAD		L/P WILL STOP IF IN UP MOTION BUT WILL CONTINUE IF IN DOWN MOTION
12.11.1.10 CB18 (C4)	CLOSE	C			ACTION CONTINUES FROM POINT OF STOPPAGE
12.11.1.11 CB19 (C3)	OPEN	D	REVERSE ACTUATOR BUS C3 WILL BE DEAD		L/P WILL STOP IF IN DOWN MOTION BUT WILL CONTINUE IF IN UP MOTION
12.11.1.12 CB19 (C3)	CLOSE	C			ACTION CONTINUES FROM POINT OF STOPPAGE
12.11.1.13 CB20 (C2)	OPEN	D	ACTUATOR BUS C2 TO POWER PACK WILL BE DEAD		POWER PACK WILL STOP
12.11.1.14 CB20 (C2)	CLOSE	C			POWER PACK WILL START

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.12.0 OPERATING TEST CONTROL PANEL AND CYCLING CONTROL STATION	ONLY TEST PLUG #1 INSERTED OPERATED FROM OPERATING TEST CONTROL PANEL DOORS OPENING				
12.12.1					
AT CYCLING CONTROL STATION					
12.12.1.1 MASTER SWITCH (A19S39) LOCAL		D F	CONTACTS ON A19S39 WILL OPEN AND DEENERGIZE THE HYDRAULIC SYSTEM		AN ACCIDENTAL OPERATION OF THIS SWITCH DURING SYSTEM OPERATION WOULD CUTOFF HYDRAULIC POWER TO THE SYSTEM
12.12.2	ONLY TEST PLUG #1 INSERTED OPERATED FROM OPERATING TEST CONTROL PANEL L/P MOVING UP				
12.12.2.1 MASTER SWITCH (A19S39) LOCAL		D F	CONTACTS ON A19S39 WILL OPEN AND DEENERGIZE THE HYDRAULIC SYSTEM		SAME AS ABOVE
12.13.0 OPERATING TEST CONTROL PANEL AND RETRACTION MECH	ONLY TEST PLUG #1 INSERTED OPERATED FROM OPERATING TEST CONTROL PANEL L/P MOVING UP				
12.13.1					

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
<u>AT RETRACTION MECHANISM LOCAL CONTROL</u> 12.13.1.1 1E1L EXTEND 12.13.1.2 3B1L EXTEND 12.13.1.3 2B1LV EXTEND 12.13.1.4 2B2LV EXTEND 12.13.1.5 1C1LV EXTEND		D F	SEE 12.8	SEE 12.8	SAFE CONDITION
12.14.0 OPERATING TEST CONTROL PANEL AND WORK PLATFORMS 12.14.1 <u>AT WORK PLATFORM LOCAL CONTROL KEY STATION</u> 12.14.1.1 WORK PLATFORM #1 EXTEND 12.14.1.2 WORK PLATFORM #2 EXTEND 12.14.1.3 WORK PLATFORM #3 EXTEND 12.14.1.4 WORK PLATFORM #4 EXTEND 12.14.1.5 WORK PLATFORM #5 EXTEND	ONLY TEST PLUG #1 INSERTED OPERATED FROM OPERATING TEST CONTROL PANEL <u>L/P MOVING UP</u>	D F	LIMIT SWITCHES 44A5, 44A6, 44A7, 44A8 ARE OPEN UNLESS THE PLATFORM IS DOWN AND AS A RESULT THE WP OPERATE RELAY (32K09) WILL BE ENERGIZED.	RELAY 16K16 (WP RETRACTED/WORK PLATFORMS WILL NOT INDICATION) WILL BE DEENERGIZED. CONTACT C6 WILL OPEN AND DEENERGIZE THE L/P RAISE DRIVE RELAY.	SAFE CONDITION
12.15.0 OPERATING TEST CONTROL PANEL AND CIRCUIT BREAKERS THE EFFECTS UPON THE SYSTEM ARE SIMILAR TO THOSE FOUND WHILE OPERATING FROM THE TUNNEL ENTRANCE CONTROL STATION THEREFORE ALL OF SECTIONS: 12.11.1.1 THROUGH 12.11.1.11 APPLY HERE.					

12.0 ERROR ANALYSIS SHEET

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
GROUND LEVEL PORTABLE CONTROL STATION AND VARIOUS CONTROL STATIONS AS LISTED BELOW					
THE EFFECTS UPON THE SYSTEM ARE SIMILAR TO THOSE FOUND WHILE OPERATING FROM THE TUNNEL ENTRANCE CONTROL STATION THEREFORE PREVIOUS SECTIONS APPLY AS INDICATED:					
12.16.0 G.L.P.C.S. AND OPERATING TEST CONTROL PANEL	SEE: 12.6				
12.17.0 G.L.P.C.S. AND WORK PLATFORMS	SEE: 12.9				
12.18.0 G.L.P.C.S. AND RETRACTION MECHANISMS	SEE: 12.8				
12.19.0 G.L.P.C.S. AND CYCLING CONTROL STATION	SEE: 12.7				
12.20.0 G.L.P.C.S. AND CIRCUIT BREAKERS	SEE: 12.11				
12.21.0 G.L.P.C.S. AND TEST PLUGS	SEE: 12.10				

CONTROL ACTUATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.22.0 REMOTE CONTROL CONSOLE (SK-191-90991)	SELECTOR SWITCH AT LAUNCHER #1 POSITION				
12.22.1	LAUNCHER #1: BRAKE DUMP VALVE OPEN LAUNCHER PLATFOM STOPPED CATASTROPHIC CIRCUIT ENERGIZED POWER PACK OFF NO-GO SIGNAL SENT TO SHUTDOWN COMMAND RETURNED TO LAUNCHER CONTROLLER	A	NONE	NONE	AT LAUNCHER #1: CATASTROPHIC CIRCUIT DEENERGIZED POWER PACK ON BRAKE RELEASED LAUNCHER PLATFOM CONTINUES DOWN OPERATOR HAS NO INDICATION OF THIS ACTIVITY AND IS UNAWARE THAT SELECTOR SWITCH HAS RESET LAUNCHER #1 THIS ERROR COULD OCCUR AT ANY TIME - BEFORE EQUIPMENT IS INSPECTED FOR SAFE ACTUATION OR WHILE EMERGENCY REPAIR CREW IS IN AN UNSAFE AREA WITHIN THE LAUNCHER
12.22.1.1 SELECTOR SWITCH CHANGED TO LAUNCHER #2 POSITION					

12.0 ERROR ANALYSIS SHEET

CONTROL ACTIVATED IN ERROR	LAUNCHER EQUIPMENT STATUS	ERROR TYPE CAUSE	FIRST INTERLOCK OR SAFETY DEVICE	SECOND INTERLOCK OR SAFETY DEVICE	CONSEQUENCE
12.22.2 NOTE: (THE MULTIPLE FAILURES CONSIDERED HERE DO NOT HAVE A HIGH PROBABILITY OF OCCURRENCE, HOWEVER, THE EMERGENCY STOP PUSHBUTTON SHOULD BE ABSOLUTELY FREE FROM FAILURE DUE TO HUMAN ERROR SHOULD ANY EMERGENCY ARISE.)	SELECTOR SWITCH AT LAUNCHER #1 POSITION OR LAUNCHER #1 KEYSWITCH IN AUTOMATIC MODE HYDROTAPPER FAILS BUFTING CYLINDERS FAIL OVERSPEED SWITCH FAILS LAUNCHER PLATFORM ACCELERATING DOWNWARD	A	NONE	NONE	LAUNCHER #1 DOES NOT STOP SAFELY SEE O.S.T.P. SITE
12.22.2.1 EMERGENCY STOP AND RESET PUSHBUTTONS ACTIVATED SIMULTANEOUSLY DUE TO PROXIMITY OF CONTROLS		L			
12.22.3 AT REMOTE CONTROL CENTER EXTEND	A MISILE MAINTENANCE CREW IS ON WORK PLATFORM #2 NEAR FACE D. THE UMBILICAL COUPLING ON MECHANISM 2B2LV IS DISCONNECTED AND THE MECHANISM IS RETRACTED. MAINTENANCE DOLLY IS STANDING ON CENTER LINE, FACE D	C	NONE	NONE	CREW MEMBERS INJURED DUE TO SWINGING MECHANISM AND/OR MISSILE DAMAGED WHEN MECHANISM THRUSTS MAINTENANCE DOLLY AGAINST MISSILE SKIN.
12.22.3.1 2B2LV		G			
SIMILAR ACCIDENTS CAN OCCUR ON SEVERAL OTHER WORK PLATFORM LEVELS INVOLVING ANY OF THE "REMOTE" CONTROLLED UMBILICAL MECHANISMS					

12.0 ERROR ANALYSIS SHEET

UNCLASSIFIED

UNCLASSIFIED