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December 30, 1963

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Submitted by: Aerojet-General Corporation

Westinghouse Electric Corporation

Astronuclear Laboratory

Pittsburgh 36, Pennsylvania

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Prepared by:

W. E. Freidhof
W. E. Freidhof

Approved by:

E. J. Ney
E. J. Ney, Supervisor

WESTINGHOUSE ASTRONUCLEAR

WANEF PRE-OPERATIONAL

SYSTEMS TESTS

Approved by:

F. D. Retallick
F. D. Retallick, Manager

MASTER

(Title Unclassified)

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ABSTRACT

Presented herein are the pre-operational systems tests which were performed at the Westinghouse Astronuclear Experimental Facility (WANEF) to ensure that all systems required for the safe and efficient operation of the facility have been installed properly and operates in accordance with the specifications set forth in the system design.

WANEF PRE-OPERATIONAL SYSTEM TESTS

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I. Introduction

Prior to performing any of the various experimental programs scheduled at WANEF, it is necessary to conduct a series of tests to insure that each system which affects the safety of the facility has been installed properly. These tests vary, depending on the nature of the system, from simple visual inspections on systems like those covered by the Building Services Tests to complete simulated operation of an entire system such as those covered by the Drum Drive System Tests.

The various tests to be conducted have been set up in the form of test procedures to insure that all systems requiring checkouts are properly covered. The various procedures to be used in performing these checkouts and a summary of the test objectives follow.

II. Conclusion

The completed pre-operational systems tests presented herein ensure that each system required for operation has been satisfactorily checked out prior to commencing operation of the facility. The tests performed indicate that all systems perform as required by the design specifications set forth for each particular system.

III. Discussion

A. Ventilation Systems

Tests to be conducted on the fuel assembly room and the test cell ventilation systems will determine the system operating characteristics. This will be accomplished by checking the installed systems against the installation drawing to insure consistency between the drawing and the actual system. Also, measurements and checks of air flows, pressure drops, interlocks, and equipment operation will be performed under various operating conditions for each of the systems.

B. Building Services

The city water system and the electrical distribution system will be checked out to insure conformance with the installation drawings. In particular, the test cell, fuel storage, and fuel assembly rooms will be thoroughly inspected to insure that no water lines exist in these areas.

C. Test Cell Equipment

The major items of equipment in the test cell require various types of inspection and testing to insure that the equipment functions in accordance with its design criteria. This is accomplished in part by inspections of the equipment at the vendors' shops and after installation at WANEF. In addition to inspecting the various components, a number of operational type checks will be performed, where applicable, to insure integrity.

D. Alarm Systems

There are a number of alarm systems employed at WANEF for use in the event that hazardous conditions arise. The checkout of these systems to determine that they function properly is a vital part of the pre-operational testing. The main objectives in testing the systems will be to insure that each system has been installed correctly and that its sensitivity, setpoints, and audibility are properly adjusted.

E. Instrumentation and Control

For purposes of insuring that all nuclear control systems are thoroughly checked prior to initial operation of the facility, a series of tests will be performed during various phases of the installation. These tests have been divided into five major groups which are as follows:

1) Electrical Interconnections:

This section of the instrumentation checkout will be completed after the interconnecting wiring has been installed from Panel B, the main junction panel, to the various control and indicating systems. The checkout will insure that wires running from Panel B are correctly installed and have been terminated at the correct positions. This will be accomplished by performing circuit continuity checks, grounding checks, and cross wiring checks.

2) Control Console Operation:

Prior to shipment from the vendor's shops, a checkout of the control console was performed to insure conformance with the design specifications. This checkout included tests of circuit logic and installed wiring performed by means of voltage checks, circuit continuity, and operation with "dummy" external loads. After the console has been installed at the facility and all required modifications have been completed, tests similar to those performed at the vendors will be repeated.

3) Interlock Systems:

After all the various interlocks provided for the safety of the facility operation have been installed, each interlock will be tested for proper operation. These tests will include checks of the action required of each interlock, such as indicator light operation, bypass and reset features, and interlocking features.

4) Control Drum Drive System Test:

The control drum drive system will be subjected to a series of tests to insure that each component of the system functions properly. The test includes a complete checkout of the control drum drive, scram mechanism, position indication system, speed regulator, switch logic, and interlocks. The tests are carried out at various stages of the system installation with a final operational test being conducted after the system is completely installed and connected to the actual control drums.

5) Nuclear Detector Checkout:

Each nuclear detector (BF_3 and CIC) will be checked out to determine the sensitivity and proper operating conditions for each detector. This will be accomplished by checking the output of the detectors when voltages on the detector are varied and also by checking the output of the detectors with a known neutron field.

PO-1a. Fuel Assembly Room Ventilation System Test1. System Installation Check

Check the system to insure that it is installed according to Patterson Drawings Nos. P5, P2, P4, L2, E3, E4. If any deviations are noted, detail them below.

Remarks: The system installation was checked and appears to be according to the drawings with the exception that the pressure gauge on the auxiliary exhaust has not been installed. Work request for installation written.

Checkout completed by: W E Truitt
Date: 10-9-63

2. System Operation Check

a. With the vacuum table operating, check the items listed below to insure proper operation of the various components.

NOTE: Where air flow rates are to be measured, the design flow rate is listed with the check.

Item	Condition	Air Flow Rate		Checked	Date
		Design (CFM)	Actual (CFM)		
Vacuum Table Exhaust	On	1000	1360		10-9-63
Hood Exhaust	Off	0	0		10-9-63
Auxiliary Exhaust	Off	0	0		10-9-63
Air Supply Unit	On	-	-		10-9-63
Ass'y Rm Inlet Air	-	700	650		10-9-63
Vault Inlet Air	-	300	150		10-9-63

Remarks: The air flow rate on the Assembly Room and Vault
supplies is lower than the design values listed due to the static
pressure regulator closing the supply damper to maintain a negative
pressure in the Assembly Room. The negative pressure in the Assembly
Room is the overriding design requirement.

Checked by: W E Freidhof Date: 10 9-63

b. With the vacuum table and hood turned off, check the following items:

1) Auxiliary Exhaust Air Flow

a) Max: 187 CFM Gage Reading -- PSIG

b) Min: 72 CFM " " -- PSIG

Remarks: The following flow rates were obtained for various
settings of the Auxiliary Exhaust Damper:

187 CFM - Damper wide open
168 CFM - " 1/2 open
147 CFM - " 1/4 open
72 CFM - " closed

Checked by: W. E. Freidhof Date: 10-9-63

2) Air Flow Into Room

When assembly room or vault door is opened, air should flow into room to insure that the spread of contamination is kept to a minimum. Insure that this occurs.

Remarks: Air flow into the assembly room when the door is opened
about 2 inches, with the vacuum table operating, is about 200 CFM.

Checked by: W. E. Freidhof Date: 10-9-63

PO-1b. Test Cell Ventilation System Test1. System Installation Check

Check the system to insure that it is installed according to Patterson Drawings Nos. P3, P4, E4. If any deviations are noted, detail them below.

Remarks: The supply and return ducts have been relocated and dampers have been installed in each at the point that they enter Test Cell. Supply diffusers now located on the south and west walls of the Test Cell. The return duct has been moved to main floor level and filters installed in the duct. These changes were required to resolve technical and nuclear safety comments. Checked by: W. E. Freidhof Date: 10-9-63

2. System Operation Check

Make the following checks when the system is operating:

a. Air Supply Diffusers Air Flow

Design flow - 4000 CFM (total)

Measured flow - 2150 CFM (total)

b. Return-Air Flow

Measure return air flow for various settings of the air control unit.

Air Control Unit Setting	Return Air Flow (CFM)
Open (Min.)	0
Closed (Max.)	1600

c. Manually trip the high radiation monitor and insure that the following occurs:

- 1) Exhaust fan stops
- 2) Supply blower continues
- 3) Return air damper D-3 closes
- 4) Supply air damper D-2 closes

Remarks: Additional heating required. Work request written.

Checked by: W. E. Freidhof Date: 10-9-63

PO-2a. Building Services1. City Water System

a. System Installation Check

- 1) Checkout system to insure that it is installed according to Patterson Drawings Nos. P1, P2. If any deviations are noted, detail them below.

Remarks: System installation appears to be in
accordance with the drawings.

Checked by: W. E. Freidhof Date: 10/10/63

- 2) Check the Test Cell to insure that all water lines have been removed, with the exception of the sump pump lines.

Checked by: W. E. Freidhof Date: 10/63

- 3) Check the fuel vault and the assembly room to insure that there are no water lines in these areas or passing over these areas.

Checked by: W. E. Freidhof Date: 10/63

2. Electrical Distribution System

a. System Installation Check

- 1) Checkout the system to insure that it is installed according to Patterson Drawings Nos. E1, E2, E3, E4. If any deviations are noted, detail them below.

Remarks: _____

Checked by: W. E. Freidhof Date: 10/63

PO-3a. PAX/PTX Test Stand - Drawing No. NT-600054

1. With the Test Stand positioned in the Test Cell, inspect the drive support plate and the reactor support plate to insure proper alignment.

Remarks: O.K. Alignment satisfactory.

Inspected by: J. Makovich Date: 10/63

2. Load test the Test Stand by placing the "test weights" listed in Table I in the positions indicated.

Table I

Component Description	Position on Stand	Actual Weight	Test Weight
Reactor	Reactor Support Ring		
Nozzle	"	300	570
P. V. Cyl	"	721	1,081
P. V. Head	"	280	420
Miscellaneous	"	500	750
12 Drive Units	Drive Support Plate	2,760	4,140
10 men	Platform	2,000	3,000

- a. With the "test weights" listed in Table I on the Test Stand, measure and record the deflection of the items listed in Table II.

Table II

Item	Deflection (Inches)	Remarks	Checked by
1. Reactor Support Ring	None observed		R. Kelly
2. Drive Support Plate	None observed		R. Kelly
3. Test Cell Floor Beams*			R. Kelly
a) Beam #1	1/32		
b) Beam #2	1/16		
c) Beam #3	7/64		

* The Test Cell floor beams are the three 18' long (14" flange) beams which support the Test Stand. The beams are numbered 1, 2, and 3 from north to south.

- b. After "test weights" have been in position for approximately two hours, check all welds on Test Stand for any signs of strain.

Remarks: No visual indications of defects in welds of Test Stand or floor under strain of load test, after load had been applied for two hours. Quality Control report on file at WANEF.

Inspected by: R. Kelly Date: 7/6/63

PO-3b. PAX-PTX Turning Stand, Drawing No. NT-600009

1. Prior to shipment from the vendor's shop, inspect the Reactor Turning Stand to insure conformance with the design drawings.

Remarks: A 12,769 pound weight was installed on Turning Stand and revolved 360°. An additional 13,200 pounds was added and the ND load test performed. Both tests were satisfactory. Quality Control report on file at WANEF.

Inspected by: A. E. Springer Date: 7-20-63
(Quality Control)

2. After the Reactor Turning Stand is positioned in the Test Cell, check the stand to insure that it is leveled and aligned properly.

Checked by: Gary Thomas Date: 10-14-63

3. Position the "dummy reactor"* on the turning stand and check and record results of the following operational checks:

- a. Forward speed: Approx. 315 Deg/Min.

Remarks: Operation satisfactory

- b. Reverse speed: Approx. 315 Deg/Min.

Remarks: Operation satisfactory

- c. Stopping time: 5 Seconds

Remark: It requires 5 seconds for brake to be applied and switch is released. Brake appears to hold in all positions. System satisfactory.

Checked by: W. E. Freidhof Date: 10-14-63

* A dummy reactor has been assembled at the Astronuclear Labs at Large to test the operation of the testing stand.

PO-3c. PAX/PTX Lifting Fixtures

1. Prior to shipping from the vendor's shops, each of the following lifting fixtures are to be inspected and tested to insure conformance with the design drawings.

a. Lifting Fixture - NT 600021

- 1) Inspect fixtures to insure conformance with drawings.

Remarks: Inspected by WANL Quality Control and the
report is on file at WANEF.

Inspected by: M. Nagy - WANL, Q.C.

- 2) Load test fixture to 25,500 pounds.

Remarks: Fixture tested with 25,700 pound load. Two tests performed, one for 4 minutes and the other for 2 minutes. Both tests successful. WANL Quality Control report on file at WANEF.

Witnessed by: M. Nagy - WANL, Q.C.

b. Lifting Fixture - NT 600048

- 1) Inspect fixture to insure conformance with drawings.

Remarks: Inspected by WANL Quality Control and the report
is on file at WANEF.

Inspected by: J. A. Bardnell, WANL, Q.C.

- 2) Load test the fixture to 25,500 pounds.

Remarks: The fixture was tested with a 25,600 pound load
and found to be satisfactory. The WANL Quality Control
report is on file at WANEF.

Witnessed by: J. A. Bardnell, WANL - Q.C.

PO-3d. Test Cell Crane

1. Inspect the Test Cell crane to insure that the following items work properly:

a. Bridge stops:

1) North X 2) South X Checked by: W. E. Freidhof Date: 10-14-63

b. Trolly stops:

1) East X 2) West X Checked by W. E. Freidhof Date 10-14-63

c. Bridge speed:

1) Design 5 ft/min2) Actual 6 ft/minChecked by W. E. Freidhof Date 10-14-63

d. Trolly speed:

1) Design 5 ft/min2) Actual 5 ft/min

e. Hoist speed:

1) Slow - Design 8 ft/minActual 8 ft/min (loaded)Actual 8 ft/min (unloaded)2) Fast - Design 24 ft/minActual 24 ft/min (loaded)Actual 24 ft/min (unloaded)Checked by W. E. Freidhof Date 10-14-63

2. Load test the Test Cell crane under the following conditions:

- a. Test weight: 30,000 pounds
- b. Test time: 30 min.
- c. Trolly position: Center of bridge

3. Measure the deflection in the crane bridge with the "test weight" in place.

- a. Deflection: 3/4 inches

Checked by: H. Kulikowski Date: 6-21-63

4. With the "test weight" on the crane, turn off the crane power and determine if there is any slippage under power failure conditions.

Remarks: The "dummy reactor" weight used for testing the Turning
Stand was lifted by the crane and then crane power was interrupted
and no slippage was noted.

Checked by: J. Makovich, G. Thomas Date: 11-8-63

PO-3e. Test Cell Floor Load Test

1. Turning Fixture Floor Test

Prior to installing the turning fixture in the Test Cell, the Test Cell floor should be load tested according to the steps outlined below.

- a. Place two lead bricks on the Test Cell floor on the positions where the turning fixture legs will be placed.
- b. Place I-beams into position on top of lead bricks.
 - 1) 2 I-beams approximately 6 ft. long on each side
 - 2) 1 I-beam approximately 16 ft. long in center
- c. Place concrete slabs on the I-beams to simulate turning stand load. Total "test weight" is listed below:

	Actual Weight	Test Weight
Turning Stand	9,000	13,500
Reactor		
Total		

- d. With simulated load in place, measure and record the deflection of the Test Cell floor beams under each support point.
 - 1) Floor beam #1 (8WF24) - Def: 5/64 inches
 - 2) Floor beam #2 (14WF30) Def: 1/16 inches
 - 3) Floor beam #3 (8WF24) Def: 1/8 inches

Witnessed by R. Kelly, WANL-Q.C. Date 7-5-63

Remarks: No apparent defects in welds when examined with 7X magnifying glass. The Quality Control report for the test is on file at WANEF.

PO-3f. Test Cell Sump Pump System Test1. Inspection

- a) Visually inspect the various parts of the system to insure that all components have been properly installed.

Remarks: Installation satisfactory.

Checked by W. E. Freidhof Date 10-8-63

2. Operation

- a) Operate the float several times and insure that the pump starts.
- b) Check the pump discharge to insure that the pump is capable of pumping the water out the discharge.

Remarks: Operated system several times and operation appeared to be satisfactory. Pumping time required to empty sump is about two minutes.

Checked by W. E. Freidhof Date 10-8-63

- c) Check the operation of the check valve in the pump discharge line. Insure that valve closes when pump stops.

Checked by W. E. Freidhof Date 10-8-63

- d) Check the manual shutoff valve on the discharge side of the pump.

Checked by W. E. Freidhof Date 10-8-63

- e) Actuate each water detector and insure that the "test cell water" light and alarm occur in both the Control Room and the Guard House.

Checked by W. E. Freidhof Date 10-8-63

PO-4a. General Alarm System

1. Checkout the system to insure that it has been installed according to Dwg. #3870729, General Alarm and Guard Annunicator Schematic. If any deviations are noted in the system as installed, detail them below.

Remarks: System appears to be installed correctly. A three.(3) second delay relay has been added to the WREC portion of the WANEF General Alarm to prevent the WANEF General Alarm from blowing when the WREC Alarm is tested on daily basis.

Completed by W. E. Freidhof Date 10-22-63

2. Depress the Control Room general alarm button and check the following:
 - a. All horns are actuated and are audible.
 - b. Horns remain on when the alarm button is released.
 - c. Horns cease to blow when reset button is depressed.

Completed by W. E. Freidhof Date 10-22-63

3. Repeat Step 2 with the Test Cell general alarm button.

Completed by W. E. Freidhof Date 10-22-63

4. Repeat Step 2 with the main entrance general alarm button.

Completed by W. E. Freidhof Date 10-22-63

5. Turn off the main 110V A-C supply and insure that the emergency power supply picks up and provides the power required to operate the system.

Completed by W. E. Freidhof Date 10-22-63

6. Sound the WREC general alarm and insure that the WREC general alarm indicator and horn sound in the WANEF Control Room.

Completed by W. E. Freidhof Date 10-22-63

7. Emergency Alarm

- a) Have the emergency alarm signals actuated at the WTR building and insure that they are audible throughout the facility.

Checked by W. E. Freidhof Date 10/63

Remarks: Alarm audible in all parts of facility with exception of
Test Cell. All of the various signals appear to be functioning
properly.

PO-4b. Radiation Monitoring System

1. Checkout the system to insure that it has been installed according to Dwg. No. 387D732, Radiation Monitoring Wiring Diagram. If any deviations are noted in the system as installed, detail them below.

Remarks: System installation and operation has been checked
and appears to be satisfactory.

Checked by W. E. Freidhof Date 10/63

2. Checkout and calibrate each channel according to the procedure given in the "Victoreen Radiation Monitor" Manual.

Checked by W. E. Freidhof Date 10/63

3. Test each alarm horn by decreasing the alarm setpoint until alarm trips. Check that the following occurs:

- a. Area alarm sounds.
- b. Control Room alarm sounds.

Checked by W. E. Freidhof Date 10/63

4. Test the emergency power by switching off the normal power and performing Step 3 again.

Checked by W. E. Freidhof Date 10/63

PO-5a. Electrical Interconnections Test1. Panel B - Main Distribution Panel

Prior to applying power to the various systems and components fed through Panel B, a terminal to terminal check from Panel B to the component or system shall be performed. This check shall include a check of circuit continuity, grounds, and proper cable markings. Reference the following drawings for interconnecting wiring between Panel B and the various other panels and components:

- 1) Panel B - 576F049
- 2) Panel C & D - 576F050
- 3) CD Stanchions - 576F047
- 4) Component Details - 576F083

a. Panel A to Panel B Interconnections Checkout:

Crosscheck each of the connections listed below to insure that each has been installed properly.

<u>Panel A Terminal</u>	<u>Panel B Terminal</u>	<u>Cable No.</u>	<u>Color Code</u>	<u>Jumpers in "A" to Ter. No.</u>
1	329	31A	Blk	5
4	330		Wh	
6	333		Red	
9	339		Grn	225
21	331		Orn	25
24	332		Blu	
26	334		Wh/Bk	
28	335		R/Bk	
29	336		G/Bk	
41	340		O/Bk	227

<u>Panel A Terminal</u>	<u>Panel B Terminal</u>	<u>Cable No.</u>	<u>Color Code</u>	<u>Jumpers in "A" to Ter. No.</u>
61	341	32A	Blk	
68	343		Wh	
69	241		Red	
71	342		Grn	
72	242		Orn	
245	253		Blu	
265	254		Wh/Bk	
285	255		R/Bk	
561	244		G/Bk	
562	246		O/Bk	
83	281	33A		103,123,143, 163,183
86	280			
91	350			
98	358		Same	118,138,158, 178,198
106	282		as	
192	351		above	
563	356			
565	357			
Spare	Spare			
Spare	Spare			
103	283	34A	Blk	83,123,143, 163,183
123	285		Wh	83,103,143, 163,183
126	284		Red	
143	275		Grn	123,83,163, 103,183
146	274		Orn	

<u>Panel A Terminal</u>	<u>Panel B Terminal</u>	<u>Cable No.</u>	<u>Color Code</u>	<u>Jumpers in "A" to Ter. No.</u>
163	277	34A	Blu	143,83,123, 103,183
166	276		W/Bk	
183	279		R/Bk	143,163,83, 123,103
186	278		G/Bk	
201	354		O/Bk	301
75	258	35A		204
76	355			
206	352		Same	
208	257		as	
241	359		above	
564	353			
Spare	Spare			
"	"			
"	"			
"	"			
11	364	36A		
12	365			
244	362			264,284
261	360		Same	
281	361		as	
			above	
Spare	Spare			
"	"			
"	"			
"	"			
"	"			

<u>Panel A Terminal</u>	<u>Panel B Terminal</u>	<u>Cable No.</u>	<u>Color Code</u>	<u>Jumpers in "A" to Ter. No.</u>
575	371	36A1	Blk	
576	372		Wh	
581	373		Red	582,580,579,578,577,46
582	374		Grn	581,580,579,578,577,46
587	375		Orn	588,586,585,584,583,66
588	376		Blu	587,586,585,584,583,66
85	377		W/Bk	84
86	378		R/Bk	
105	379		G/Bk	104
106	380		O/Bk	
125	381	36A2		124
126	382			
145	383		Same	144
146	384		as	
165	385		above	164
166	386			
185	387			184
186	388			
Spare	Spare			
Spare	Spare			

Checkout Completed by R. Stoltz Date 7/63

- b. Panel B to the console and Panel B to the Test Cell inter-connections:

Crosscheck each of the connections listed below to insure that each has been installed properly.

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
1	Blk	1	CDS1-1
	Wh	2	" 2
	Red	3	" 3
	Grn	4	" 4
	Orn	5	" 5
	Blu	6	" 6
	W/Bk	7	" 7
	R/Bk	8	" 8
	G/Bk	9	" 9
	O/Bk	10	" 10
2		11	CDS1-13
		12	" 14
	Same	13	" 15
	as	16	" 18
	above	18	" 20
		20	" 12
		21	" 21
		22	" 22
		23	" 23
		24	" 24

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
3	Blk	25	CDS1-25
	Wh	26	" 26
	Red	27	" 27
	Grn	28	" 28
	Orn	29	" 29
	Blu	30	" 30
	W/Bk	31	" 33
	R/Bk	32	" 34
	G/Bk	33	" 35
	O/Bk	38	" 40
4		40	CDS1-32
		41	" 41
		42	" 42
	Same	43	" 43
	as	44	" 44
	above	45	" 45
		46	" 46
		47	" 47
		48	" 48
5		49	" 49
	Blk	50	CDS1-50
	Wh	51	" 53
	Red	52	" 54
	Grn	53	" 55

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
5	Orn	58	CDS1-60
	Blu	60	" 52
	W/Bk	61	" 61
	R/Bk	62	" 62
	G/Bk	63	" 63
	O/Bk	64	" 64
6		65	CDS1-65
		66	" 66
	Same	67	" 67
	as	68	" 68
	above	69	" 69
		70	" 70
		71	" 73
		72	" 74
		73	" 75
		74	" 76
7		78	CDS1-80
		80	" 72
		81	CDS2-81
	Same	82	" 82
	as	83	" 83
	above	84	" 84
		85	" 85
		86	" 86
		87	" 87
		88	" 88

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
8	Blk	89	CDS2- 89
	Wh	90	" 90
	Red	91	" 93
	Grn	92	" 94
	Orn	93	" 95
	Blu	98	" 100
	W/Bk	100	" 92
	R/Bk	101	" 101
	G/Bk	102	" 102
	O/Bk	103	" 103
9		104	CDS2-104
		105	" 105
		106	" 106
		107	" 107
	Same	108	" 108
	as	109	" 109
	above	110	" 110
		111	" 113
		112	" 114
		113	" 115
10	Blk	118	CDS2-120
	Wh	120	" 112
	Red	121	" 121
	Grn	122	" 122
	Orn	123	" 123

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
10	Blu	124	CDS2-124
	W/Bk	125	" 125
	R/Bk	126	" 126
	G/Bk	127	" 127
	O/Bk	128	" 128
11	Blk	129	CDS2-129
	Wh	130	" 130
	Red	131	" 131
	Grn	132	" 134
	Orn	133	" 135
	Blu	138	" 140
	W/Bk	140	" 132
	R/Bk	141	" 141
	G/Bk	142	" 142
	O/Bk	143	" 143
12		144	" 144
		145	" 145
		146	" 146
		147	" 147
	Same	148	" 148
	as	149	" 149
	above	150	" 150
		151	" 153
		152	" 154
		153	" 155

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
16	Blk	198	CDS3-200
	Wh	200	" 192
	Red	201	" 201
	Grn	202	" 202
	Orn	203	" 203
	Blu	204	" 204
	W/Bk	205	" 205
	R/Bk	206	" 206
	G/Bk	207	" 207
	O/Bk	208	" 208
17		209	CDS3-209
		210	" 210
		211	" 213
	Same	212	" 214
	as	213	" 215
	above	218	" 220
		220	" 212
		221	" 221
		222	" 222
		223	" 223
18	Blk	224	CDS3-224
	Wh	225	" 225
	Red	226	" 226
	Grn	227	" 227

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
18	Orn	228	CDS3-228
	Blu	229	229
	W/Bk	230	230
	R/Bk	231	233
	G/Bk	232	234
	O/Bk	233	235
19	Blk	238	CDS3-240
	Wh	240	" 232
	Red	245	C245-SDC1
	Grn	247	C247-SDC1
	Orn	251	Popper in Cell
	Blu	252	" " "
	W/Bk	258	C258-Cell Gamma Horn
	R/Bk	259	C259- 3 Min. Horn
	G/Bk	260	C260 " " "
	O/Bk	271	Cell Veto
20	Blk	272	" "
	Wh	273	" "
	Red	329	C329
	Grn	330	C330
	Orn	331	C331
	Blu	332	C332
	W/Bk	333	C333
	R/Bk	334	C334
	G/Bk	335	C335
	O/Bk	336	C336

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
21	Blk	337	D.P.S.
	Wh	338	"
	Red	339	C339
	Grn	340	C340
	Orn	341	C341
	Blu	342	C342
	W/Bk	343	C343
	R/Bk	344	D.P.S.
	G/Bk	345	"
	O/Bk	346	"
22	Wh	347	CDS3-347
	Red	348	" 348
	Grn	349	" 349
	Orn	350	" 350
	Blu	351	" 351
	W/Bk	354	" 354
	R/Bk	355	" 355
	G/Bk	357	" 357
	O/Bk	358	" 358
	Blk	363	" 363
23	G/Bk	359	CDS3-359
	O/Bk	360	" 360
	Blk	361	" 361
	Wh	362	" 362

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
23	Red	364	CDS3-364
	Grn	365	" 365
	Orn	366	" 366
	Blu	--	--
	W/Bk	--	--
	R/Bk	--	--
24	Blk	401	Panel AA - P11-1
	Wh	402	" " 2
	Red	403	" " 3
	Grn	404	" " 4
	Orn	405	" " 5
	B;u	406	" " 6
	W/Bk	407	" " 7
	R/Bk	408	" " 8
	G/Bk	409	" " 9
	O/Bk	410	" " 10
25A		411	Panel AA - P11-11
		412	" " 12
		413	" " 13
		414	" " 14
	Same	415	" " 15
	as	416	" " 16
	above	417	" " 17
		418	" " 18
		419	" " 19
		420	" " 20

<u>Console Cable No.</u>	<u>Color Code</u>	<u>Panel B Terminal No.</u>	<u>Component or Panel Terminal No.</u>
25A-1	Blu	303	C303
	W/Bk	304	C304
	R/Bk	305	C305
	G/Bk	306	C306
	O/Bk	307	C307
25A-2		377	C377
		378	C378
		379	C379
	Same	380	C380
	as	381	C381
	25A	382	C382
		383	C383
		384	C384
		385	C385
		386	C386
25A-3	G/Bk	387	C387
	O/Bk	388	C388
		494	Water Level Det.
		497	" " "

Checkout Completed by R. Stoltz Date 7/63

PO-5b. Control Console Operation1. Interconnections

After all internal wiring connections on the control console have been completed, each connection to the terminal boards on the console should be checked to insure proper installation. The terminal board connections are listed below along with the necessary information to check them.

TB	Continuity to	Voltage Applied by	Opera- tional Check	TB	Continuity to	Voltage Applied by	Opera- tional Check
1-1		110V AC Line	x	5-1		MSW 6	x
1-2		110V AC Line	x	5-2	4-10/5-4		x
				5-3		MSW 7	x
2-1	F5		x	5-4	5-2/5-6		x
2-2	K36B/1		x	5-5		MSW 8	x
2-3	F9	Master Key	x	5-6	5-4/5-8		x
		Switch		5-7		MSW 9	x
2-4	K15A	MSW on		5-8	5-6/5-10		x
		Recorder		5-9		MSW 10	x
2-5	2-6	Popper		5-10	5-8		x
2-6	2-5	Popper					
2-7	K18		x	6-1		DSW 13	x
2-8			x	6-2		DSW 1	x
2-9	K19		x	6-3			x
2-10	F6		x	6-4	IG5	Gnd	x
				6-5	IY5	Gnd	x
3-1		SW6	x	6-6		DSW 14	x
3-2		SW	x	6-7		DSW 2	x
3-3				6-8			x
3-4		Gnd	x	6-9	IG6	Gnd	x
3-5		Gnd	x	6-10	IY6	Gnd	x
3-6	F5		x				
3-7		MSW 11	x	7-1		DSW 15	x
3-8	3-10		x	7-2		DSW 3	x
3-9		MSW 12	x	7-3			x
3-10	3-8/4-2		x	7-4	IG7	Gnd	x
				7-5	IY7	Gnd	x
4-1		MSW 1	x	7-6		DSW 16	x
4-2	3-10/4-4		x	7-7		DSW 4	x
4-3		MSW 2	x	7-8			low retn
4-4	4-2/4-6		x	7-9	IG8	Gnd	x
4-5		MSW 3	x	7-10	IY8	Gnd	x
4-6	4-4/4-8		x				
4-7		MSW 4	x	8-1		DSW 17	x
4-8	4-6/4-10		x	8-2		DSW 5	x
4-9		MSW 5	x	8-3			low retn
4-10	4-8/5-2		x	8-4	IG9	Gnd	

<u>TB</u>	<u>Continuity to</u>	<u>Voltage Applied by</u>	<u>Operational Check</u>	<u>TB</u>	<u>Continuity to</u>	<u>Voltage Applied by</u>	<u>Operational Check</u>
8-5	IY9	Gnd	x	13-1			
8-6		DSW 18	x	13-2			
8-7		DSW 6	x	13-3			
8-8			low retn	13-4			
8-9	IG 10	Gnd	x	13-5			
8-10	IY 10	Gnd	x	13-6			
				13-7			
9-1		DSW 19	x	13-8			
9-2		DSW 7	x	13-9			
9-3			low retn	13-10		internal console	
9-4	IG 11	Gnd	x				
9-5	IY 11	Gnd	x	14-1		terminal board	
9-6		DSW 20	x	14-2			
9-7		DSW 8	x	14-3		Daystrom, Inc., checked	
9-8			x	14-4			
9-9	IG 12	Gnd	x	14-5			
9-10	IY 12	Gnd	x	14-6			
				14-7			
10-1		DSW 21	x	14-8			
10-2		DSW 9	x	14-9			
10-3			x	14-10			
10-4	IG 13	Gnd	x				
10-5	IY 13	Gnd	x	15-1	15-2		x
10-6		DSW 22	x	15-2	15-1		x
10-7		DSW 10	x	15-3	K17		x
10-8			x	15-4		110V AC line	x
10-9	IG 14	Gnd	x	15-5		110V AC line	x
10-10	IY 14	Gnd	x	15-6	5V AC		x
				15-7	bypass lite		x
11-1		DSW 23	x	15-8		Not Used	
11-2		DSW 11	x	15-9	switch power		x
11-3			x	15-10	" "		x
11-4	IG 15	Gnd	x				
11-5	IY 15	Gns	x	16-1	16-2		x
11-6		DSW 24	x	16-2	16-1		x
11-7		DSW 12	x	16-3	16-4		x
11-8			x	16-4	16-4		x
11-9	IG 16	Gnd	x	16-5	16-6		x
11-10	IY 16	Gnd	x	16-6	16-5		x
				16-7	16-8		x
12-1				16-8	16-7		x
12-2				16-9	16-10		x
12-3		internal console		16-10	16-9		x
12-4							
12-5		terminal board		17-1	PAI #1		Wiring
12-6				17-2			Continuity
12-7		Daystrom, Inc., checked		17-3			Check
12-8				17-4			
12-9				17-5			
12-10				17-6			
				17-7			

<u>TB</u>	<u>Continuity</u> <u>to</u>	<u>Voltage</u> <u>Applied by</u>	<u>Wiring</u> <u>Contin-</u> <u>uity</u> <u>Check</u>	<u>TB</u>	<u>Continuity</u> <u>to</u>	<u>Voltage</u> <u>Applied by</u>	<u>Wiring</u> <u>Contin-</u> <u>uity</u> <u>Check</u>
17-8	PAI #2		x	20-8	PAI #8		x x
17-9			x	20-9			x x
17-10			x	20-10			x x
17-11			x	20-11			x x
17-12			x	20-12			x x
17-13			x	20-13			x x
17-14			x	20-14			x x
18-1	PAI #3		x	21-1	PAI #9		x
18-2			x	21-2			x
18-3			x	21-3			x
18-4			x	21-4			x
18-5			x	21-5			x
18-6			x	21-6			x
18-7			x	21-7			x
18-8	PAI #4		x	21-8	PAI #10		x
18-9			x	21-9			x
18-10			x	21-10			x
18-11			x	21-11			x
18-12			x	21-12			x
18-13			x	21-13			x
18-14			x	21-14			x
19-1	PAI #5		x	22-1	PAI #11		x
19-2			x	22-2			x
19-3			x	22-3			x
19-4			x	22-4			x
19-5			x	22-5			x
19-6			x	22-6			x
19-7			x	22-7			x
19-8	PAI #6		x	22-8	PAI #12		x
19-9			x	22-9			x
19-10			x	22-10			x
19-11			x	22-11			x
19-12			x	22-12			x
19-13			x	22-13			x
19-14			x	22-14			x
20-1	PAI #7		x	23-1	23-3		x
20-2			x	23-2		F13	x
20-3			x	23-3	23-1		x
20-4			x	23-4		Symplitrol	x
20-5			x	23-5	K15B		x
20-6			x	23-6	K24B	Interlock bypass	x
20-7			x	23-7	SW7A/C	Panel A	x
				23-8	SW7A/N.C.	Panel A	x
				23-9	SW7A/N.O.	Panel A	x
				23-10		Interlock	x
				23-11		Symplitrol meter	x

TB	Continuity to	Voltage Applied by	Opera- tional Check	TB	Continuity to	Voltage Applied by	Opera- tional Check
23-12		Symplitrol meter	x	27-11		5V AC	x
23-13	K24	Panel A	x	27-12		Gnd	x
23-14	K24	Panel A	x	27-13	SW com.		x
23-15	K37B/1		x	27-14	SW N.C.		x
				27-15	SW N.O.		x
24-1				27-16		5V AC	x
24-2				27-17		Gnd	x
24-3				27-18	SW com.		x
24-4		F5	x	27-19	SW N.C.		x
24-5	IR1	Gnd	x	27-20	SW N.O.		x
24-6	IB1	Gnd	x				
24-7	IR2	Gnd	x	28-1			x
24-8	IB2	Gnd	x	28-2			x
24-9	IR3	Gnd	x	28-3			x
24-10	IB3	Gnd	x	28-4			x
				28-5			x
25-1	IR4	Gnd	x	28-6			x
25-2	IB4	Gnd	x	28-7			x
25-3	IR5	Gnd	x	28-8			x
25-4	IB5	Gnd	x	28-9			x
25-5	IR6	Gnd	x	28-10			x
25-6	IB6	Gnd	x	28-11			x
25-7	IR7	Gnd	x	28-12			x
25-8	IB7	Gnd	x	28-13			x
25-9	IR8	Gnd	x	28-14			x
25-10	IB8	Gnd	x	28-15			x
				28-16			x
26-1	IR9	Gnd	x	28-17			x
26-2	IB9	Gnd	x	28-18			x
26-3	IR10	Gnd	x	28-19			x
26-4	IB10	Gnd	x	28-20			x
26-5	IR11	Gnd	x				
26-6	IB11	Gnd	x	29-1	INL 1 reset		x
26-7	IR12	Gnd	x	29-2	INL 1 "		x
26-8	IB12	Gnd	x	29-3	INL 2 "		x
26-9	K23	Panel	x	29-4	INL 2 "		x
26-10		FL4	x	29-5	INL 3 "		x
				29-6	INL 3 "		x
27-1		5V AC	x	29-7	INL 4 "		x
27-2	lite com.	Gnd	x	29-8	INL 4 "		x
27-3	SW C		x	29-9	INL 5 "		x
27-4	SW N.C.		x	29-10	INL 5 "		x
27-5	SW N.O.		x	29-11	INL 6 "		x
27-6		5V AC	x	29-12	INL 6 "		x
27-7	lite com.	Gnd	x	29-13		12V DC	x
27-8	SW com.		x	29-14		12V DC	x
27-9	SW N.C.		x	29-15		12V DC	x
27-10	SW N.O.		x	29-16		12V DC	x
				29-17)			
				29-18)	Spares -- not used.		
				29-19)			
				29-20)			

2. Instrument Operation

Complete the following checkout on 1) the startup range channel, 2) the three linear level channels, and 3) the two log level channels.

a) Calibration:

Calibrate each instrument according to the appropriate calibration procedure given in the vendor's operating instructions manual.

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b) Trip Points:

Check each instrument to insure that all "trips" are functioning properly. The various "trips" on the instruments are listed below:

1) Linear micro-micro ammeters -

(a) High level scram

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2) Log N - Period Amplifiers

(a) High level and period scrams

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3) Linear and Log Channels High Voltage

(a) Loss of voltage scram

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4) Startup Range

(a) Flux up interlock

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c) Log Channel Selector Switch:

- 1) With selector switch on one channel, the level, period, and high voltage failure scrams for the second channel should be bypassed.

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- 2) Insure that the selected channel is displayed on the recorder and that the recorder follows the meter.

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d) Linear Channel Switch:

- 1) Insure that with the selector switch in channel #1 position, Ch #1 is displayed on the recorder and Ch #3 level and high voltage scrams are bypassed.

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- 2) Insure that with the selector switch in the channel #2 position, Ch #2 is displayed on the recorder and Ch #1 level and high voltage scrams are bypassed.

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- 3) Insure that, with the selector switch in the Ch #3 position, Ch #3 is displayed on the recorder and Ch #2 level and high voltage scrams are bypassed.

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PO-5c. Interlock Systems Test

After all the instrumentation and control circuitry has been installed, complete the following checks on the various interlock systems. Prior to commencing the check, all control systems should be placed in their normal condition for reactor operation.

1. Cell Door Interlock

a) Open the test cell door and insure that the following occur:

- 1) Drum clutches deenergize.
- 2) Door interlock light (red) on console is illuminated.
- 3) Cell door lights on "Panel A" changes from green to red.

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b) Close the test cell door and insure that the door interlock does not reset until the reset button on the console is depressed.

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c) Place the test cell door bypass switch in the bypass condition and check the following:

- 1) Amber bypass light on Panel A is illuminated.
- 2) With cell door open, the drum clutches cannot be energized until the eleven drum keys are captured in the console "drum key capture locks."

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Remarks: Only one drum clutch can be energized when bypass
is in operation, (as designed).

2. Repeat Step 1 for the test cell truck door.

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3. Repeat Step 1 for the labyrinth door.

Completed by W. E. Freidhof Date 10/15/63

4. Repeat Step 1 for the emergency door.

Completed by W. E. Freidhof Date 10/15/63

5. Repeat Step 1 for the front gate.

Completed by W. E. Freidhof Date 10/15/63

6. Repeat Step 1 for the rear gate.

Completed by W. E. Freidhof Date 10/15/63

7. Cell Veto

- a. Place the Test Cell Veto in the "Veto" position and check the following:

- 1) Green veto light in test cell is illuminated.

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- 2) Red veto light on console is illuminated.

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- 3) Drum clutches are deenergized and cannot be energized.

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- b. Reset the test cell veto and check the following:

- 1) Red "Veto Reset" light in test cell is illuminated.

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- 2) Red "Veto" light on console goes out.

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8. Minimum Count Rate

- a) With the count rate at a point below that required to satisfy the "minimum count rate" interlock, insure that the drum motor power is off.

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- b) With the count rate at a point above that required to satisfy the "minimum count rate" interlock, check the following:

- 1) Drum motor power can be obtained.
- 2) Warning Horn sounds.

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- c) Drop the count rate below the interlock point and insure that the drum motor power goes off.

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PO-5d. Control Drum Drive System Checkout1. Drive Mechanism Performance Tests

- a) Time versus displacement curves (scram) and deceleration values in the ranges of angular movement indicated below:

1. 180 degrees to 0 degrees.
2. 150 degrees to 0 degrees.
3. 120 degrees to 0 degrees.
4. 90 degrees to 0 degrees.
5. 60 degrees to 0 degrees.
6. 30 degrees to 0 degrees.

This is to be performed on each of the thirteen mechanisms. All values related to scram velocity, deceleration, and electrical decay times at the magnetic clutches are to be entered in the appropriate section of the test log book and recorded on the attached data sheet.

- b) Cyclic operation of the overall mechanism - initial test

During this phase of the test, the overall mechanism is to undergo cyclic operation; that is, all elements of the system are to be operated on a continuous basis in the following manner:

- 1) Energize the electric motor in order to produce clockwise motion of the mechanism shaft.
- 2) Energize the magnetic clutch.

- 3) Rotate the mechanism shaft a total of 180 degrees in the clockwise direction.
- 4) Reverse the travel of the electric motor and drive the mechanism shaft to the 0 degrees position.
- 5) Adjust the mechanism limit switches in order to de-energize the electric motor at both the 0 degrees and 180 degrees positions. (Indicating lights are to form a part of the limit switch circuitry.)
- 6) The following values are to be entered in the appropriate section of the test log book and recorded on the attached data sheet:
 - a) Clutch voltage values.
 - b) Clutch current values.
 - c) Motor field voltage.
 - d) Motor field current.
 - e) Motor armature voltage.
 - f) Motor armature current.
- 7) A complete position indication system is to be utilized during the performance of this test. The P.I. system is to be observed in the areas of operation listed below. Pertinent remarks relative to the operation of the system should be entered in the appropriate section of the log book.

- (a) Response of system during both clockwise and counter-clockwise rotation of the mechanism main shaft.
 - (b) Repeatability of the system in both directions.
- 8) This test is to be performed on each of the thirteen mechanisms. Total number of cycles required is 100.
- c) Cyclic Operation of the Overall Mechanism - final test

During this test, the overall mechanism is to undergo cyclic operation; that is, all elements of the system are to be operated on a continuous basis in the following manner:

- 1) Energize the electric motor in order to produce clockwise motion of the mechanism shaft.
- 2) Energize the magnetic clutch.
- 3) Rotate the mechanism shaft a total of 180 degrees in the clockwise direction.
- 4) De-energize the magnetic clutch in order to cause scram to occur.
- 5) Adjust the mechanism limit switches in order to de-energize the electric motor at both the 0 degrees and 180 degrees positions. (Indicating lights are to form a part of the limit switch circuitry.)

- 6) The following values are to be entered in the appropriate section of the test log book and recorded on the attached data sheet:
 - a) Clutch voltage values.
 - b) Clutch current values.
 - c) Motor field voltage.
 - d) Motor field current.
 - e) Motor armature voltage.
 - f) Motor armature current.
- 7) This test is to be performed on each of the thirteen mechanisms. The first mechanism received from the manufacturer shall be continuously operated for a total of 5,000 cycles. The remaining twelve mechanisms shall be continuously operated for a total of 200 cycles.
- 8) Voltage and current values where specified shall be entered in the test log book once per hour during each normal work day.

PAX/PTX DRUM DRIVE AND SCRAM MECHANISM TEST DATA

Assembly Number	DA-1	DA-2	DA-3	DA-4	DA-5	DA-6	DA-7	DA-8	DA-9	DA-10	DA-11	DA-12	DA-13
1. Total Scram Time (seconds)													
a. 180°-0°	.320	.310	.330	.380	.300	.360	.340	.380		.300	.340	.290	.300
b. 150°-0°	.315	.270	.320	.360	.280	.340	.285	.340		.250	.290	.250	.250
c. 120°-0°	.300	.250	.300	.320	.270	.310	.285	.340		.250	.290	.250	.250
d. 90°-0°	.260	.220	.270	.280	.235	.280	.250	.310		.230	.270	.220	.220
e. 60°-0°	.250	.200	.265	.250	.225	.260	.240	.300		.210	.230	.210	.205
f. 30°-0°	.200	.180	.220	.230	.190	.225	.210	.260		.180	.200	.180	.170
2. Mechanism Scram Time (seconds)													
a. 180°-0°	.290	.290	.315	.350	.285	.330	.320	.350		.290	.320	.270	.285
b. 150°-0°	.285	.255	.300	.320	.265	.305	.280	.335		.260	.300	.255	.235
c. 120°-0°	.265	.230	.280	.280	.250	.290	.270	.305		.240	.275	.230	.220
d. 90°-0°	.225	.205	.240	.240	.205	.250	.235	.270		.220	.255	.200	.190
e. 60°-0°	.215	.185	.235	.200	.195	.240	.210	.250		.185	.215	.180	.175
f. 30°-0°	.155	.160	.180	.180	.165	.195	.190	.210		.160	.170	.150	.130
3. Magnet Decay Time (seconds)													
a. 180°-0°	.030	.020	.015	.030	.015	.030	.020	.030		.010	.020	.020	.015
b. 150°-0°	.030	.015	.020	.040	.015	.035	.020	.025		.010	.020	.015	.035
c. 120°-0°	.035	.020	.020	.040	.020	.020	.015	.035		.010	.015	.020	.030
d. 90°-0°	.035	.015	.030	.040	.030	.030	.015	.040		.010	.015	.020	.030
e. 60°-0°	.035	.015	.030	.050	.030	.020	.030	.050		.025	.015	.030	.030
f. 30°-0°	.045	.020	.040	.050	.025	.030	.020	.050		.020	.030	.030	.040
4. Maximum Deceleration (radians/sec ²)													
a. 180°-0°	528	572	484	484	704	440	550	484		616	594	704	704
b. 150°-0°	484	572	484	484	704	418	638	462		638	616	715	715
c. 120°-0°	484	572	495	484	704	407	638	450		616	638	726	704
d. 90°-0°	462	561	418	473	682	374	594	429		616	704	704	682
e. 60°-0°	528	550	462	440	770	396	616	418		748	638	671	704
f. 30°-0°	286	308	187	264	374	264	275	176		330	286	440	462

PAX/PTX Drum Drive and Scram Mechanism Test Data (continued)

	DA-1	DA-2	DA-3	DA-4	DA-5	DA-6	DA-7	DA-8	DA-9	DA-10	DA-11	DA-12	DA-13
5. Clutch Current (amperes)	255	260	260	260	260	260	260	260		240	260	260	240
6. Clutch Voltage (volts)	90	90	90	90	90	90	90	90		90	90	90	90
7. Armature Current (amperes)	120	140	138	135	148	145	145	145		107	110	120	125
8. Armature Voltage (volts)	129	130	130	130	130	131	130	131		131	132	131	132
9. Field Current (amperes)	45	46	46	46	46	46	46	46		45	45	45	45
10. Field Voltage (volts)	55	56	58	56	58	57	58	58		57	58	58	58
11. Total Number of Cycles	5,065	300	300	300	300	300	300	300		307	300	300	300

Checkout completed by J. Makovich Date 9/14/63

Remarks: DA-9 orifice in wrong position - returned to manufacturer
for rework. This unit will be used as a spare. Tests will
be completed prior to installation, if required.

2. Control Drum Drive System Operational Checkout

The following checkout of the control drum drive system should be completed after the entire system, including control drums, has been installed.

a) In-Out Switch Operation:

1) Depress Drum #1 "Out" button and check the following:

- (a) Drum #1 rotates out.
- (b) Drum #1 stops when any other "Out" button is depressed.
- (c) Drum #1 continues to rotate "Out" when any other "In" button is depressed.

Completed by W. E. Freidhof Date 11/6/63

Remarks: All drum IN-OUT switches appear to operate
satisfactorily.

2) Repeat Step 1) for all other drums.

b) Drum Speed:

- 1) Place the "Drum Speed Selector" in position #5 and measure the time required to drive each drum from zero to 180° in 45° increments. Plot drum speed versus position on an appropriate graph for each drum.

2) Repeat step 1) for the remaining four drum speeds.

Remarks: Drum speed #1 does not drive any of the 12
drives. A table showing average drum speed for each drum
is attached. Drum speed #2 and #3 adequate for slowest movement.

Completed by W. E. Freidhof Date 10/19/63

Control Drum Drive		Speed Selector No.				
Pos.	No.	1 Deg/Min	2 Deg/Min	3 Deg/Min	4 Deg/Min	5 Deg/Min
1	DA-1	-	6.0	19.3	31.5	65.1
2	DA-2	-	5.5	19.5	31.5	64.2
3	DA-3	-	4.4	19.2	32.4	64.7
4	DA-4	-	5.8	19.5	31.6	65.6
5	DA-5	-	6.3	21.6	32.0	65.6
6	DA-6	-	4.0	16.5	29.0	64.3
7	DA-7	-	5.5	19.4	31.0	64.4
8	DA-8	-	7.1	21.2	33.5	66.2
-	DA-9	Returned to manufacturer for rework.				
10	DA-10	-	10.0	23.1	34.2	68.9
11	DA-11	-	7.6	21.6	32.4	66.7
12	DA-12	-	4.8	19.6	31.6	66.4
9	DA-13	-	7.2	20.7	31.9	66.7

NOTE: Speed No. 1 will not drive any of the drum drives and Speed No. 2 will not drive above about 120 degrees.

c) Drum Position Indication:

1) Position Repeatability Tests:

- (a) Drive each drum from zero to 90° a minimum of four times and, with the use of an appropriate angle indicator located on the drive, measure the variation between the actual drum position and the console indication. Record below the ~~maximum~~ and average variations in the drum position as indicated on the control console.

<u>Drum No.</u>	<u>Drive No.</u>	<u>Maximum Error</u> (degrees)	<u>Average Error</u> (degrees)
1	DA-1	0.006	0.001
2	DA-2	0.006	0.002
3	DA-3	0.006	0.002
4	DA-4	0.003	0.001
5	DA-5	0.000	0.000
6	DA-6	0.000	0.000
7	DA-7	0.012	0.008
8	DA-8	0.003	0.001
9	DA-13	0.003	0.003
10	DA-10	0.000	0.000
11	DA-11	0.006	0.002
12	DA-12	0.003	0.001

d) Drum Drive Scram Tests:

- 1) Rotate each drum to 180° and depress the Manual Scram button. Measure and record the total time required for the drum to rotate to zero. Compare the scram times for this test with the times obtained during the initial scram tests performed prior to installation of the drive mechanisms.

DRUM SCRAM CHECKS

<u>Drum No.</u>	<u>Drive No.</u>	<u>Scram Time on Bench (M Sec)</u>	<u>Scram Time on Test Stand (M Sec)</u>	<u>Scram Time Difference (M Sec)</u>
1	DA-1	320	380	60
2	DA-2	310	420	110
3	DA-3	330	422	92
4	DA-4	380	465	85
5	DA-5	300	375	75
6	DA-6	360	410	50
7	DA-7	340	405	65
8	DA-8	380	510	130
9	DA-13	300	360	60
10	DA-10	300	400	100
11	DA-11	340	435	95
12	DA-12	290	360	70

Remarks:

The differences measured in the scram times between the bench and test stand tests can be accounted for by the following differences in the setups:

- 1) Lack of the scram spring simulating the drum effect during the tests on the test stand. This force was applied during the "bench tests." It is calculated that this spring (24 in-lbs) has a 5% effect on scram time.
- 2) Introduction of the "scram relays" into the "test stand" tests. These relays introduced approximately a 7% increase in the overall scram times.
- 3) The method used to measure the scram time for the "bench and test stand" tests was different and some of the change in the scram times can be attributed to the change in the measurement method. The main changes in the two methods used to measure the scram times were:
 - a) High speed recorder for the bench test and a scope for the test stand tests.
 - b) Special switches were used to trigger the trace on the bench tests and the IN and OUT switches were employed in the test stand tests.

- 4) The clutch current in the two tests varied somewhat and in all cases was higher during the tests on the test stand. This effect introduced an increase in the test stand scram tests amounting to about 1% of the total scram time.
- 5) System meets requirements of WANL-TNR-099
- 2) Check the delay time introduced by the scram relays (K21, K22, and K23).

Remarks: Scram times for the three scram relays were measured using Drum #12, the results are as follows:

1. K23 - 10-15 msec
2. K22 - 10-15 msec
3. K21 10-15 msec

Note: Part 2, Control Drum System Operational Checkout, will be repeated after all control drums are installed to insure proper operation of the entire system.

PO-5e. Detector Checkouts

a) Detector High Voltage Plateau:

- 1) Set the BF_3 detector high voltage at about 100 volts and position the RaBe source at a point near the detector such that the log CRM reads about 1000 CPM.
- 2) Reduce the voltage to zero.
- 3) Increase the detector high voltage in 100 volt steps and record the count rate on the log CRM. Continue increasing the voltage until the detector saturates or until voltage reaches 3000 volts.
- 4) Plot the count rate vs. voltage on an appropriate chart.
- 5) Set the detector voltage at a value which is on the lower end of the voltage plateau of the plot of counts vs. voltage.

b) Discriminator:

With the RaBe source in the position of Step a)1), perform the following steps to set the discriminator level.

- 1) With the amplifier gain set at the value used in Step a, above, vary the discriminator setting from 0.1 volts to 10 volts (full scale).
- 2) Record and plot count rate vs. disc setting in volts for every 0.5 volt steps.
- 3) Repeat Steps 1 and 2 for an amplifier gain lower than that of Step 1 and for an amplifier gain higher than that of Step 1.

3. Detector Sensitivities

- a) Place the 0.5 curie PuBe neutron source at a fixed distance (36") from each type detector and record the reading on the appropriate instrument. Compare these readings with the calculated values given in the table.

<u>Detector</u>	<u>Sensitivity</u>	<u>Calculated Response</u> ^{1/}	<u>Actual Response</u>
Startup-BF ₃	13 counts/NV	5200 CPM	8500 CPM
DAS BF ₃	72 counts/NV	29,000 CPM	16,000 CPM ^{2/}
CIC	10 ⁻¹⁴ Amps/NV	2.7 x 10 ⁻¹³ Amps	5 x 10 ⁻¹³ Amps

Remarks: The variation in the "calculated and actual responses" for the Startup BF₃ and the CIC's is attributed to the polyethylene which surrounds each detector.

The difference noted between the calculated and the actual responses for the DAS-BF₃ is attributed to the fact that the BF₃ was operating at 3250 volts and its design operating voltage is about 4200 volts. This reduced voltage is used to increase the life of the detector.

^{1/} Calculated values based on 0.5 curie PuBe source at 36" from detector.

^{2/} Maximum H.V. of 3250V and amplifier gain of 32X1.

12-17-63 W.E.F.

10⁴

9
8
7
6
5
4
3
2

10³

9
8
7
6
5
4
3
2

COUNTS PER MINUTE

START-UP CHANNEL
BF₃ HIGH VOLTAGE
PLATEAU
DET. TYPE: W 6998 - BF₃
DET. VOLTAGE VS COUNT RATE (CPM)

H.V. SETPOINT
(1950 VOLTS)

DETECTOR VOLTAGE

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