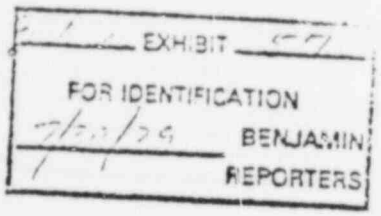
GPU 2308

THREE MILE ISLAND NUCLEAR STATION
ANNUAL REQUALIFICATION EXAM
CYCLE 5 1978-1979



APPLICANT _____

DATE _____

LICENSE TYPE RO/SRO
(Circle One)

INSTRUCTIONS TO APPLICANT:

Use separate paper for the answers. Keep each Category separate and staple the question sheet on top of the answer sheets. Points for each question are indicated in parenthesis after the question. Each Category question sheet contains directions as to which questions are to be answered by an RO and/or SRO. A Category score of less than 80% requires FSR makeup.

CATEGORY VALUE		% OF TOTAL		APPLICANT'S SCORE	% OF CAT. VALUE	CATEGORY
RO	SRO	RO	SRO			
1.5	11.5	15.2	12.8			A. Principles of Reactor Theory (A, H)
11.0	11.0	14.5	12.2			B. Features of Facility Design (B)
11.5	12.5	15.2	13.9			C. General & Specific Operating Characteristics (C, J)
10.0	10.0	13.2	11.1			D. Instruments & Controls (D)
11.0	11.0	14.5	12.2			E. Safety & Emergency Systems (E)
10.0	11.0	13.2	12.2			F. Standard, Emergency & Administrative Procedures Limits & Precautions (F,L)
10.75	11.5	14.2	12.8			G. Radiation Control & Safety (G, I)
N/A	11.5	N/A	12.8			H. Fuel Handling & Core Parameters (K)
75.75	90.0	100%	100%		TOTALS	

Final Grade _____ % Approved by: _____

CATEGORY A (A, H)
PRINCIPLES OF REACTOR THEORY

RO - 11.5 pts
SRO - 11.5 pts

O - RO Answers
* - SRO Answers
O* - RO and SRO Answer

O 1. a) What is meant by the term "delayed neutron fraction"? (1.0)

b) How and why does the delayed neutron fraction change over core lifetime? (1.5)

O 2. Assume Keff = 0.9. Calculate the amount of reactivity addition required to attain criticality. (1.0)

O* 3. Explain how individual rod worth varies:

a) With its radial position (1.0)

b) If another rod is placed next to it (1.0)

c) If moderator temperature increases (1.0)

O* 4. a) A reactor has a constant stable SUR of 0.5 DPM; how long will it take for power to rise from 10^{-10} amps to 5×10^{-8} amps? Show all work. (1.0)

b) What is the value of the reactor period for this transient? (0.5)

c) What is the value of Keff for this transient? (1.0)

O* 5. Samarium - 149 and Xenon - 135 are both reactor poisons.

a) Write the production schemes for each starting with the major fission product. Include half-life values. (1.0)

b) Explain why Xenon reactivity effects present a greater problem than that of Samarium. (1.5)

* 6. a) A shutdown reactor core has a Keff less than one, yet has an indicated constant count rate. Explain why this can be true. (1.0)

b) Explain why the count rate will increase with control rod withdrawal while the reactor is still subcritical. (1.0)

* 7. a) Explain in detail why the moderator temperature coefficient is negative. (1.0)

b) Explain why the value of the moderator temperature coefficient changes over core life. (0.5)

CATEGORY B
FEATURES OF FACILITY DESIGN

RO - 11.0 pts
SRO - 11.0 pts

O* RO and SRO Answer All

O* 1. Explain the purposes of the following plant design features:

a) OTSG Aspirating Steam Ports (1.0)

b) RCP Flywheel Assemblies (1.0)

c) RCP Anti-Reverse Rotation Devices (1.0)

O* 2. a) What is the purpose of the RC Drain Tank? (0.5)

b) How would the control room operator determine if a discharge into the tank was occurring? (0.5)

c) List three (3) indications of a leaking pressurizer safety valve. (1.0)

O* 3. When the manual reactor trip pushbutton is depressed all CRD motors are deenergized, but only rod groups 1-7 drop into the core.

a) What feature of facility design prevents the rods in Group 8 from falling into the core? Be specific. (0.5)

b) Explain why this feature is necessary. (1.0)

O* 4. a) Briefly describe why the Emergency Feedwater System is put into operation following loss of all four RCP's - even <u>without</u> a loss of main feedwater. (1.0)

b) Describe the response of the main feedwater system (valves and pumps) upon loss of all four RCP's. Assume main feedwater pumps do not trip. (1.0)

O* 5. Part of the fire protection system at this station consists of a number of pumps located in each unit. The fire main supplies hydrants, hose reels, wet pipe sprinklers and deluge systems.

a) List all the pumps which supply water to the fire main, their capacity, and pressure setpoint for automatic start. (1.0)

b) Explain the operation of a deluge valve as applied on the Natural Draft Cooling Towers. (1.0)

c) How do you manually actuate a natural draft cooling tower deluge valve? (0.5)

CATEGORY C (C/J)
GENERAL AND SPECIFIC OPERATING CHARACTERISTICS

RO - 11.5 pts
SRO - 12.5 pts

O - RO Answers
* - SRO Answers
O* - RO and SRO Answers

O 1. A regulating control rod adds negative reactivity as it is inserted. Explain how an Axial Power Shaping Rod (APSR) can add positive reactivity when it is inserted. (1.0)

O 2. Following a Steam Line Break Accident the possibility exists to excessively repressurize the reactor coolant system.

a) Explain why this condition exists. (1.0)
b) What operator actions will prevent this from occurring? (1.0)

O* 3. Assume that the plant is operating at 100% FP, all ICS stations are in automatic.

On the attached figure C-1:

a) Show the initial conditions for each parameter. (1.0)

b) Assuming a reactor trip occurs, plot the response of the parameters for five (5) minutes. (2.0)

O* 4. The Makeup and Purification system uses the following chemicals during operation. Explain why they are used and when they are used during plant operation:

a) Lithium Hydroxide (1.0)
b) Hydrazine (1.0)
c) Hydrogen (1.0)

O* 5. The regulating control rod groups are withdrawn with a normal amount of overlap.

a) What is the value for normal overlap? (0.5)

b) How is this overlap verified? (1.0)

c) What characteristics of the reactor and the control rods make it desirable to operate with overlap? (1.0)

* 6. If an excessive Quadrant Power Tilt condition exists a minimum requirement is that power must be reduced below the power level cutoff.

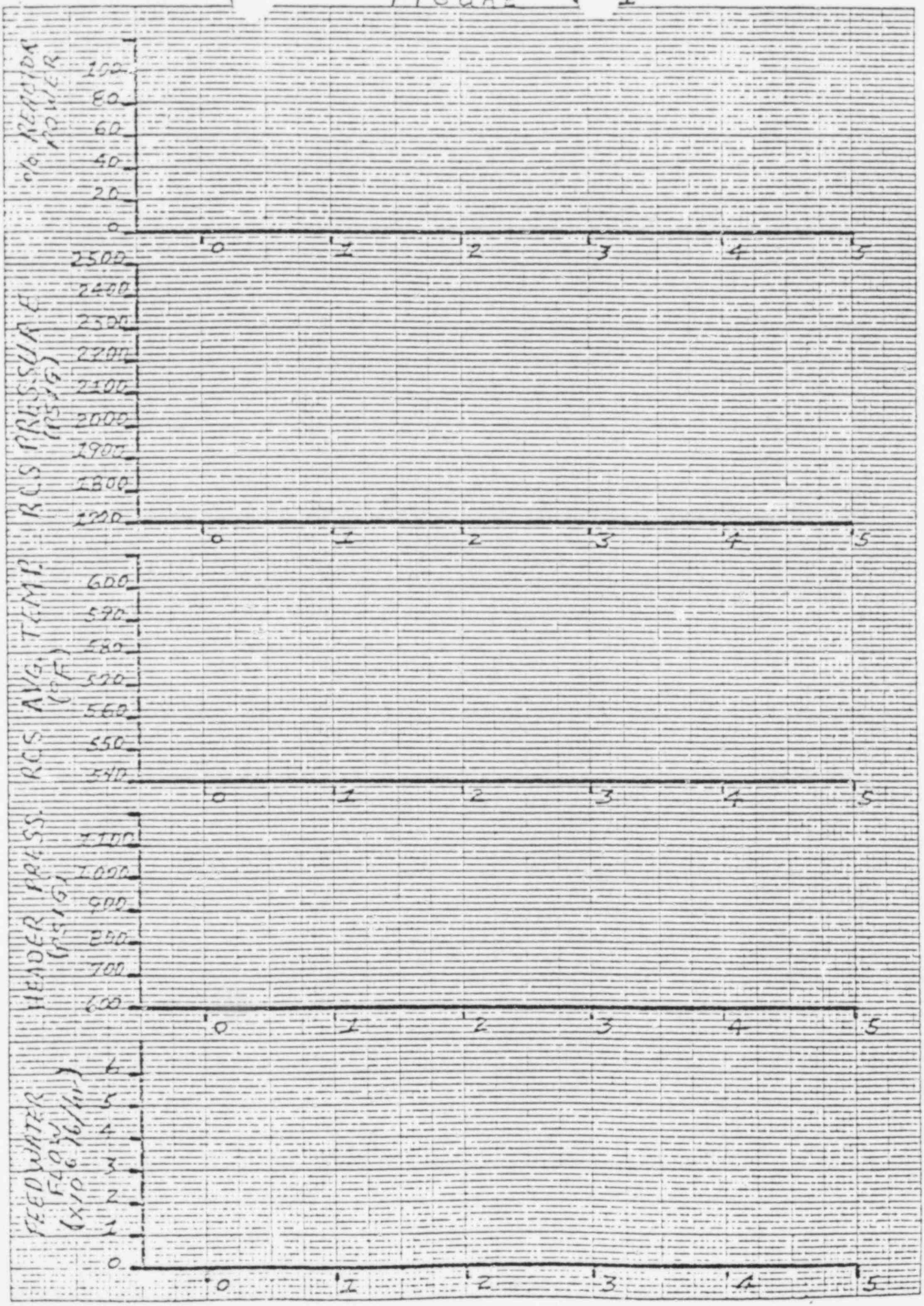
a) Define Quadrant Power Tilt. (0.5)
b) What is the value of Power Level Cutoff? (0.5)
c) During normal operations what conditions must be met prior to exceeding the power level cutoff? Why? (1.0)

7. On the attached figure C-2:
(Unit 1 (A) and Unit 2 (B))

a) Mark with an X the lights that are lit for 100% FP operation. (1.0)

b) Mark with a circle the lights that are lit assuming a dropped rod in Group 4. (1.0)

FIGURE 1


% REHEATER
100
80
60
40
20
0
RCS PRESSURE (PSIG)
2500
2400
2300
2200
2100
2000
1900
1800
1700
RCS AVG. TEMP. (°F)
600
590
580
570
560
550
540
HEADER PRESS. (PSIG)
1100
1000
900
800
700
600
FEEDWATER FLOW (10^6 lb/hr)
6
5
4
3
2
1
0
0
1
2
3
4
5

CATEGORY D
INSTRUMENTATION AND CONTROL

RO - 10.0 pts
SRO - 10.0 pts

O* - RO and SRO Answer All

O* 1. With the aid of a sketch, explain how the Cross Limit circuits are developed within the ICS. (2.0)

O* 2. Describe the development for each type of control rod position indication used at this station. (2.0)

O* 3. a) What is the purpose for the ICS BTU Limits? (0.5)

b) What parameters are monitored in the development of the BTU Limit? (1.0)

c) Which direction (increase, decrease) must each of the individual parameters go to lower the BTU Limit. Assume reference conditions at 100% power. (1.0)

O* 4. Consider a turbine trip from 100% power with feedwater and reactor in automatic. Reactor power and feedwater flow are reduced by the ICS - the plant stabilizes at 15% reactor power.

a) What terminates the reactor plant runback at 15%? (0.5)

b) Why is this setpoint desirable? For instance, why don't we run the plant back to 5% F.P.? Be specific. (1.0)

O* 5. a) Describe why the source range OOC nuclear instruments are deenergized on a plant startup. (0.5)

b) Describe the logic (normal and backup) utilized to automatically deenergize these detectors. Include setpoints. (1.5)

Category E (E)
Safety and Emergency Systems

RO - 11.0 pts
SRO - 11.0 pts

O* - RO and SRO Answers

O* 1. List the conditions which will automatically trip an Emergency Diesel Generator after an automatic E.S. start signal is received. (2.0)

O* 2. a) Describe how the main steam line rupture detection system (feedwater latch) is actuated. (1.25)

b) What protective action is automatically initiated by its actuation? (0.75)

O* 3. List all the reactor protection system trips, for 100% FP, include the Technical Specification setpoint for each trip. (2.0)

O* 4. Make a simple sketch showing the flowpath of water during the injection phase of safety injection for:

a) High pressure injection (1.5)

b) Low pressure injection (1.5)

O* 5. Certain substances will cause a charcoal filter to be degraded

a) What are the general classifications for these substances? (1.0)

b) Give an example (substance) for each general classification given in part "a". (1,0)

CATEGORY F (F,L)
STANDARD, EMERGENCY, AND ADMINISTRATIVE PROCEDURES
LIMITS AND PRECAUTIONS

RO - 10.0 pts
SRO - 11.0 pts

O - RO Answers
* - SRO Answers
O* - RO and SRO Answers

O 1. List the allowable steady state quadrant power tilt limits for the following methods of measurement:

a) Symmetrical (full) incore system. (0.25)
b) Minimum incore system (0.25)
c) Power range channels (0.25)

O 2. For the following emergency conditions, list the unique indication(s) of each, as given in the emergency procedure:

a) Loss of reactor coolant inside containment (0.75)
b) OTSG tube rupture (0.75)
c) Steam line break inside containment (0.75)

O* 3. a) List the conditions, as given in the emergency procedure, which would warrant small break LOCA response. (1.0)

b) How much time, by procedure, does the CRO have to recognize that a small break LOCA condition exists? (0.5)

c) How long, by procedure, does the Small Break LOCA team have to get the leg flows balanced at 125 gpm? (0.5)

O* 4. The control rod drive emergency procedure states that in the event of an asymmetric rod condition to verify plant runback.

a) What conditions must be satisfied to get the automatic runback? (2.0)
b) Does the ICS runback for an asymmetric rod condition always satisfy Technical Specification requirements? Explain (2.0)

O* 5. Briefly explain the purpose of "Caution Tags". (1.0)

* 6. List the emergency procedure symptoms for a "High Activity in Reactor Coolant" condition. (1.5)

* 7. The control room for the purpose of defining the area for the "Operator-at-the-Controls" is divided into the routine operations area and nonroutine operations area.

a) List three (3) conditions which warrant the "Operator-at-the-Controls" entering the nonroutine operations area. (1.5)
b) On the attached Figure F-1 (Unit I (A) or Unit II (B) Control Room as applicable) mark the routine operations area for the "Operator-at-the-Controls". (1.0)

CATEGORY G (G, I)
RADIATION CONTROL AND SAFETY

RO - 10.75 pts
SRO - 11.5 pts

O - RO Answers
* - SRO Answers
O* - RO and SRO Answers

O 1. You've been working two hours next to a hot spot which has a field intensity of 1200 mrem at one foot. You note that your dosimeter has pegged high and you leave the controlled access. You were working two feet from the hot spot.

a) What was your exposure? (1.5)

b) If you've already received 900 mrem this quarter, what is your total quarterly dose? (0.25)

c) What Administrative and/or NRC limits have you exceeded? (0.5)

O 2. What are the TMI entry requirements for areas with greater than 100 mrem/hr doserate? (1.0)

O* 3. For each of the following list:

i) Activity monitor(s) that would sense the problem
ii) Automatic actions associated with the monitor(s)
iii) Monitor locations
iv) Type of detector used

a) High level liquid radwaste release. (1.0)
b) Spent Fuel Element failure. (1.0)
c) High level waste gas decay tank release. (1.0)

O* 4. a) Define "Radiation Area" (1.0)

b) Define "Contaminated Area" (1.0)

O* 5. You're exiting the controlled access area and you discover the sole of your shoe is contaminated. A buddy hands you a piece of tape and you remove the contamination. What further actions should you take before leaving the access area entrance? (1.5)

O* 6. What is the difference between a RAD and a REM? (1.0)

* 7. List the criteria for declaration of a Local Radiation Emergency. (2.0)

* 8. a) List the three major sources of Tritium at TMI. (1.5)

b) Describe the hazards associated with Tritium. (1.0)

SRO ATTACHMENTS

Category H (K)
Fuel Handling and Core Parameters

SRO - 11.5 pts

* SRO Answers

* 1. a) Briefly explain why an installed artificial neutron source is used. (1.0)

b) What type of artificial neutron source is installed in the core? (0.5)

c) What are the core locations for the installed artificial neutron sources? (0.5)

* 2. a) What is the reason for the mechanical maneuvering rates limit on the rate of reactor power increase below 20% FP? (1.0)

b) What is the rate of increase allowed by the mechanical maneuvering rates below 20% FP? (0.5)

* 3. Define the following:

a) F_Q (1.0)

b) $F^N_{\Delta H}$ (1.0)

* 4. What prevents the fuel grapple from engaging or disengaging at the wrong time. (2.0)

* 5. a) What is the formula for subcritical multiplication? (0.5)

b) Assume Keff = 0.9 when the countrate is 10 cps. Sometime later during the fuel loading the countrate has increased to 20 cps. Show calculations for the following:

1. What is the new Keff of the reactor? (1.0)

2. What would be the status of the reactor if the same amount of reactivity was added to the reactor as was added to increase the countrate from 10 cps to 20 cps? (1.0)

* 6. Name the Refueling Technical Specification for the following:

a) Flux Monitoring (0.75)

b) Communications (0.75)

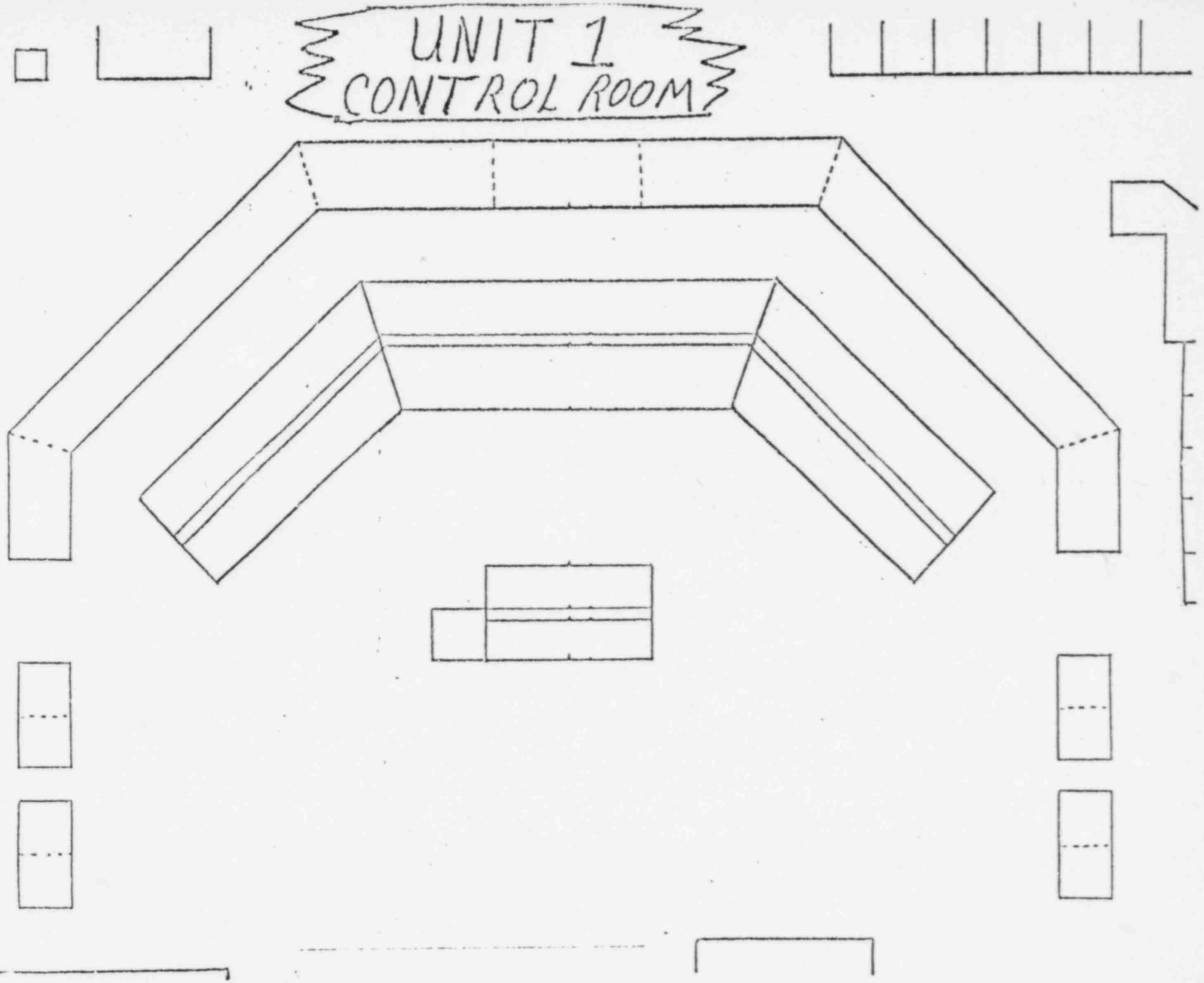
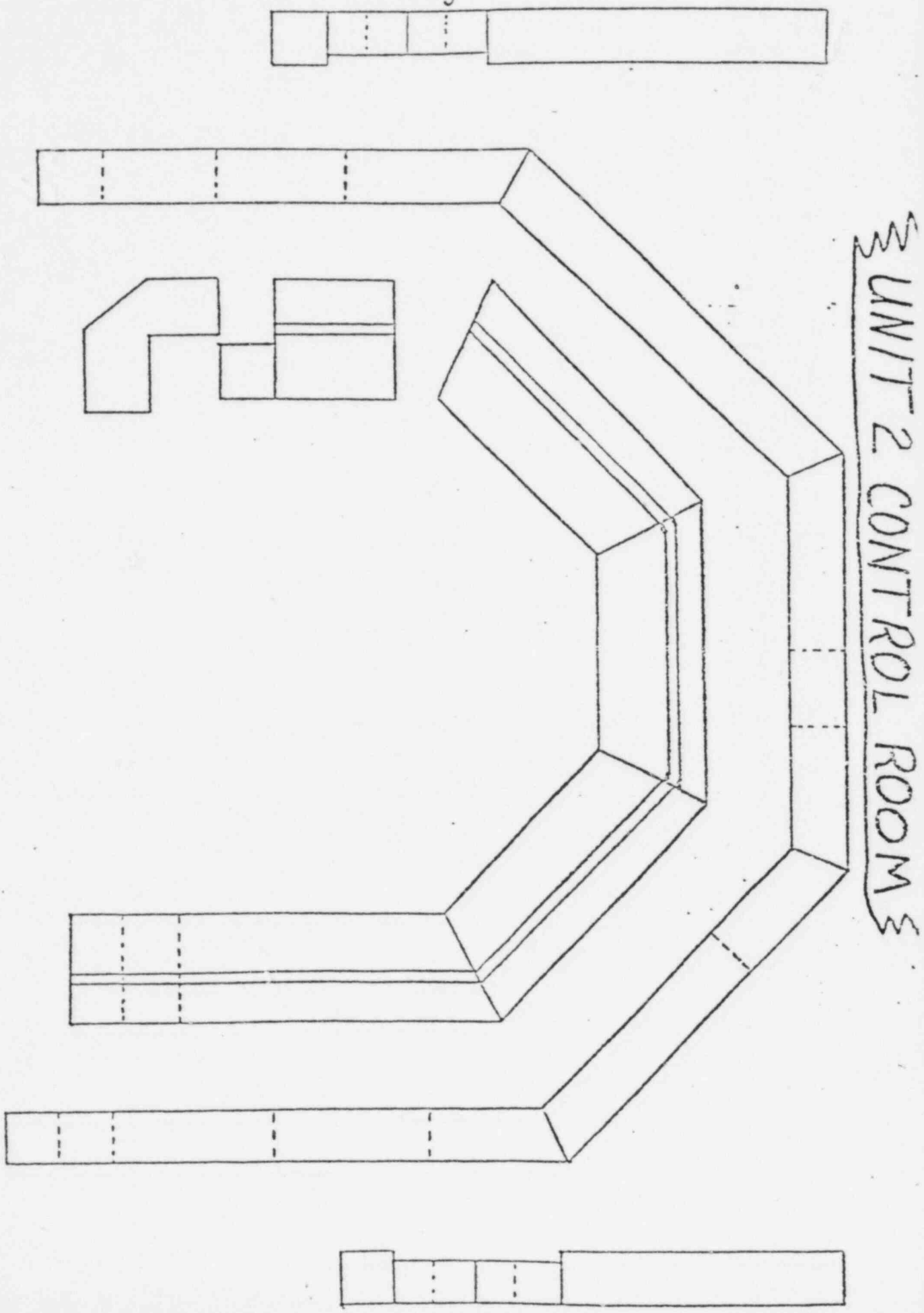


Figure F-1A

Figure 1 F-1B



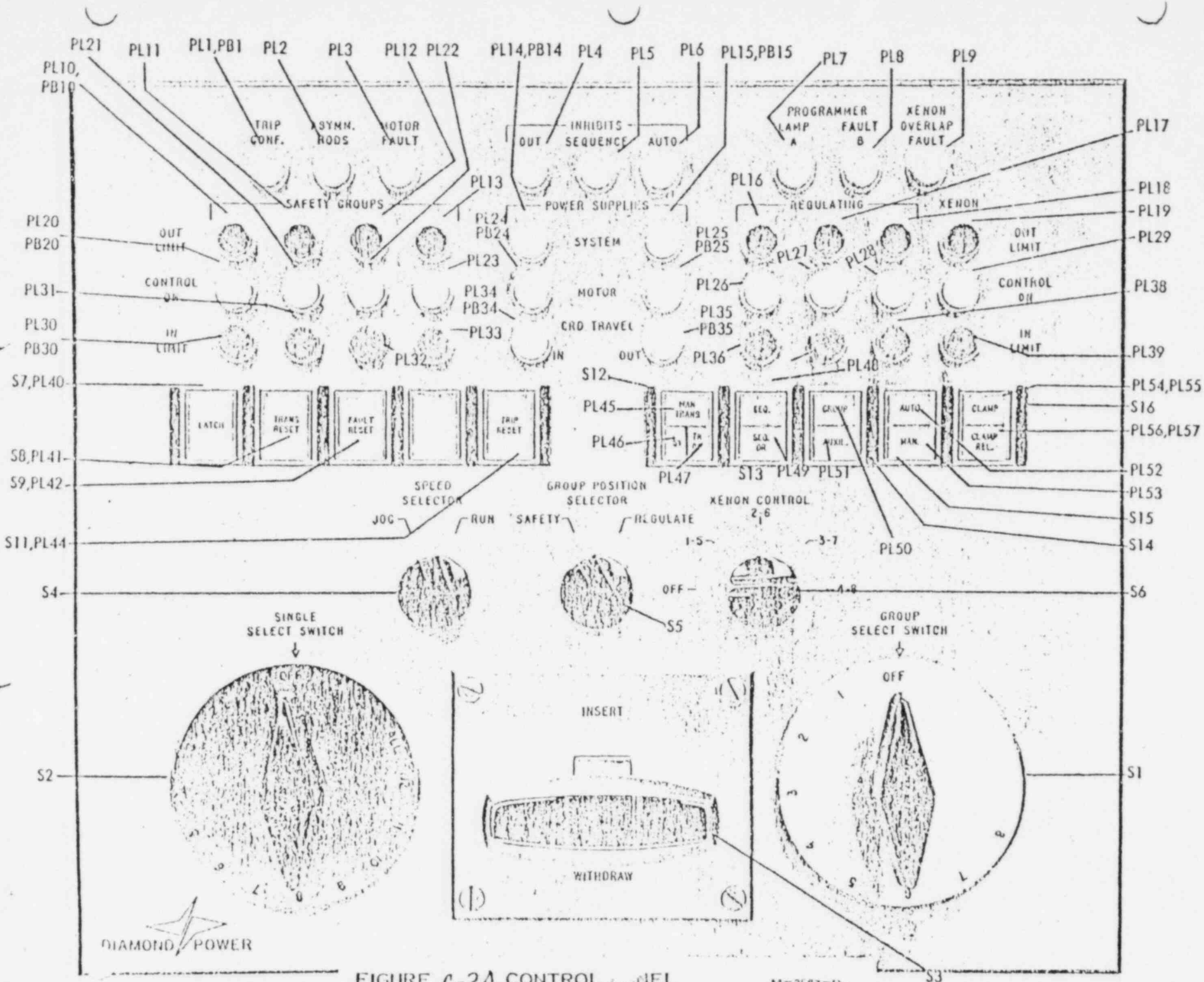


FIGURE C-2A CONTROL PANEL

M-2587-D

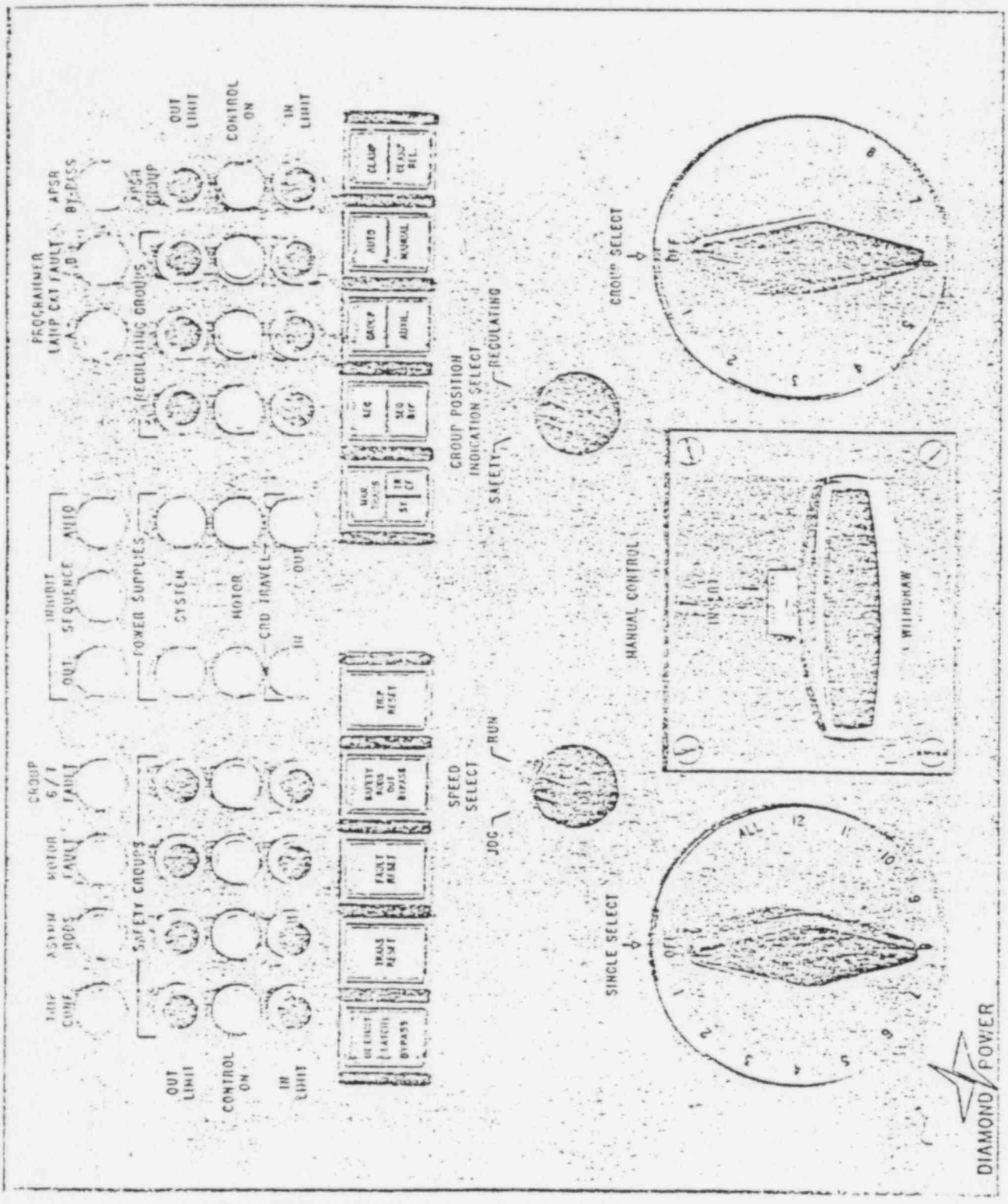


FIGURE C-2B CONTROL PANEL

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