U. S. NUCLEAR REGULATORY COMMISSION REGION I
OPERATOR LICENSING EXAMINATION REPORT

EXAMINATION REPORT NO. 50-289/85-13

FACILITY DOCKET NO. 50-289

FACILITY LICENSE NO. DPR-50

LICENSEE: GPU Nuclear Corporation
Post Office Box 480
Middletown, Pennsylvania 17057

FACILITY: Three Mile Island, Unit 1

EXAMINATION DATES: April 5, 1985 and April 18-19, 1985

CHIEF EXAMINER: for W. Dudley, Lead Examiner — Date: 5/14/85

REVIEWED BY: R. M. Keller, Chief, Projects Section 1C — Date: 5/14/85

APPROVED BY: H. B. Kister, Chief, Projects Branch No. 1 — Date: 5/14/85

SUMMARY: Three candidates were examined and one RO and one SRO license were issued. All candidates performed well on the simulator portion of the examination.

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REPORT DETAILS

TYPE OF EXAMS: Replacement X

EXAM RESULTS:

	RO Pass/Fail	SRO Pass/Fail
Written Exam	0/1	1/0
Oral Exam	1/0	1/0
Simulator Exam	2/0	1/0
Overall	1/1	1/0

1. Chief Examiner at Site: J. Huenefeld, PNL
2. Other Examiners: N. Dudley, NRC

1. Personnel Present at Exit Interview:

NRC Personnel

N. Dudley

NRC Contractor Personnel

J. Huenefeld

Facility Personnel

M. Ross
R. Magg

2. Summary of NRC Comments made at exit interview:

An exit interview was held for the simulator portion of the examination on April 5, 1985 at Lynchburg, Virginia. The NRC stated that all candidates were clear passes and had performed well on a wide variety of difficult major casualties. The facility stated that the scenarios were taxing and provided a good test of their candidates.

An exit interview was held by Mr. J. Huenefeld on April 18, 1985, at the TMI-1 facility. It was stated that both candidates were clear passes on the oral portion of the examination.

3. Changes Made to Written Exam During Examination Review:

Answer No.	Change	Reason
1.9	Also accept "b. Both sources are classified as regenerative neutron sources"	Training manual on Neutron sources Section N-6 page 17 states "TMI-1 uses two ... regenerative neutron sources".
2.9	Change to "Nothing, orifice rod assembly (ORA) has been removed from the guide tube."	OPA's were removed for cycle 5 as indicated by the cycle 5 reload report.
2.12	Include "MFW pump"	Includes the MFW pump as a major component in the flowpath to feed a dry OTSG.
3.16	Full credit given if damper is not mentioned.	Damper is interlocked with fan rather than with RMS.

Answer No.	Change	Reason
4.14c	Not graded.	Item C did not appear in question.

Attachment: Written Examination and Answer Key (RO)

U. S. NUCLEAR REGULATORY COMMISSION

REACTOR OPERATOR LICENSE EXAMINATION

Reviewed W/Ross 4/18/85
C.M. Apley 4/18/85

Facility: TMI-1

Reactor Type: B&W

Date Administered: April 18, 1985

Examiner: Apley, Huenefeld, Dudley

Candidate: _____

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheet. Points for each question are indicated in parenthesis after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

Category Value	% of Total	Candidate's Score	% of Cat. Value	Category
25	25			1. Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow
25	25			2. Plant Design Including Safety and Emergency Systems
25	25			3. Instruments and Controls
25	25			4. Procedures: Normal, Abnormal, Emergency, and Radiological Control
100				TOTALS

Final Grade _____ %

All work done on this examination is my own; I have neither given nor received aid.

_____
Candidate's Signature

1.0 PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW (25 points)

Label the following statements as TRUE or FALSE:

1.1 Because of the delay in cooldown, isolation of one OTSG when both are leaking may increase the integrated dose since the release will continue from the unisolated OTSG for a longer period. (0.5)

1.2 The NPSH limit does not apply for RCP bumps. (0.5)

1.3 The faster a pump rotates, the greater its required NPSH. (0.5)

1.4 Keeping the zircaloy clad temperatures below 2200°F will prevent any zircaloy-water reaction from taking place. (0.5)

1.5 If a 100 Ci Co-60 source is placed 1 foot behind a 4 foot high shield that blocks all direct radiation, then the area 6 feet from the sheild would be a radiation area due to air scattered radiation (sky-shine). (0.5)

1.6 Decay heat following a reactor trip is caused primarily by fissions due to delayed neutrons. (0.5)

For the questions below, choose the MOST CORRECT answer:

1.7 A reactor trip occurs during a startup due to a station blackout; decay heat generation is minimal. Approximately how fast will primary system pressure decrease due to pressurizer heat losses? (.75)

a. 70-150 psi/minute (4200 - 9000 psi/hour)
b. 10 psi/minute (600 psi/hour)
c. 70-150 psi/hr (1.2 - 2.5 psi/min)
d. 10 psi/hr. (0.12 psi/min)

- Section 1 Continued on Next Page -

1.8 Which one of the following statements about a small break in the Pressurizer Steam Space (open PORV) at power is FALSE? (.75)

a. RCS pressure drops as the pressurizer steam space is vented out the break; pressurizer level increases.

b. Pressure drops to the RPS trip setpoint; the reactor trips.

c. When pressurizer fills solid, two-phase natural circulation is lost.

d. Without isolation of the PORV, a solid water cooldown would be required.

1.9 Which one of the following statements about the TMI-1 installed neutron source is TRUE. (.75)

a. The sources are placed as close to the source range detectors as possible.

b. Both sources are classified as regenerative neutron sources.

c. Sources are necessary to start up a reactor since there are no intrinsic neutron sources in a shutdown reactor core.

d. The sources are placed on opposite sides of the core.

e. The sources are placed together, in the region of highest potential flux (core center).

1.10 Which of the following statements about water hammer is FALSE? (.75)

a. There is usually more danger of water hammer in vertical water lines than in horizontal water lines.

b. A good general rule to prevent serious consequences due to water hammer is to always open or close valves, which regulate the flow of any fluid, slowly.

c. Keeping vents or drains shut while cutting in a line helps to prevent water hammer.

d. Where bypass valves are provided around large valves, the bypass should be used to equalize pressures and temperatures before opening the large valve.

- Section 1 Continued on Next Page -

Answer the following questions:

1.11 AP-1203-1 (Load Rejection) states that if you have a significant load rejection between 230 to 280 EFPD, rod worth and boron worth may not be sufficient to overcome peak Xenon. Explain what action should be taken to maintain the reactor critical and why this action is effective. (1.5)

1.12 Why is there a longer period (at least ten (10) minutes) prior to recording data from incore detectors, than there is for excore detectors, following any control rod group motion or power change? 2.0)

1.13 If initial count rate is 100 cps with a shutdown margin of 4%, what is the new value of countrate if shutdown margin is reduced to 3%. Show method of calculation. (2.5)

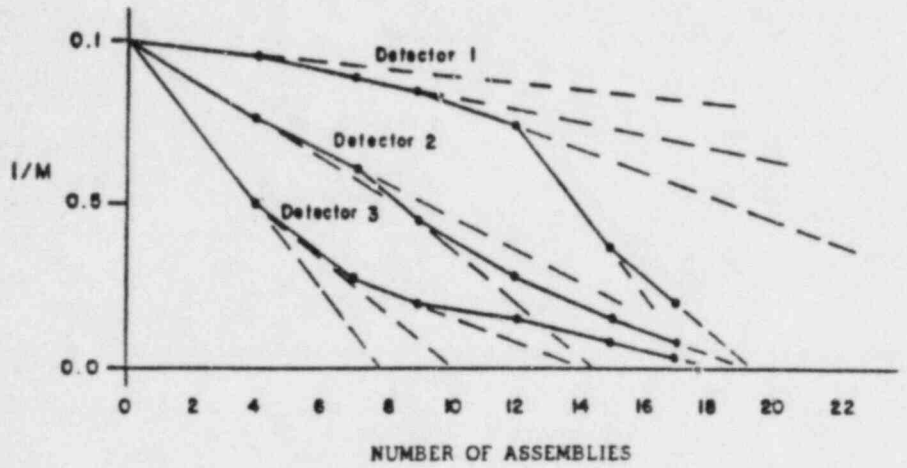
1.14 Why does Xenon peak later following a shutdown from high power than it does when following a shutdown from a low power level? (2.5)

1.15 SUR is 1 dpm. You insert an amount of negative reactivity (x) to lower SUR to 1/2 dpm. If you insert another identical amount of negative reactivity (x), will the SUR be exactly zero? Explain. (2.0)

1.16 Assuming no air leakage into the main condenser, where do the noncondensible gases in the feedwater come from? (1.0)

- Section 1 Continued on Next Page -

1.17 The figure below shows a 1/M plot versus number of fuel assemblies being added. Curves are provided for three detector locations. Which detector is sited too far away from the fuel assemblies being added? Explain your answer. (2.0)



1.18 Identify the following systems as subcooled, saturated, or superheated: (3.0)

a. Pressurizer sys.

b. Reactor coolant sys.

c. Main steam sys.

d. High pressure turbine exhaust steam

e. Low pressure turbine inlet steam

f. Main condenser sys.

- Section 1 Continued on Next Page -

1.19 During power operations at 20% power with three (3) reactor coolant pumps (RCPs) in operation the forth RCP (loop A) is started. Briefly DISCUSS the final steady state value of the following parameters: (2.5)

a. Hot leg temp, Cold leg temp, and Delta T (in the loop with two pumps)

b. Feed flow (Each OTSG)

- End of Section 1 -

2.0 PLANT DESIGN, INCLUDING SAFETY AND EMERGENCY SYSTEMS (25 POINTS)

Label the following statements as TRUE or FALSE:

2.1 The OTSG tube to shell Delta-T limit is a "one way" limit--that is, the concern is having the tubes colder than the shell NOT the shell colder than the tubes. (0.5)

2.2 Either L.P. heater string may be bypassed for maintenance and plant operation at rated power continued. (0.5)

2.3 The MUT outlet valve, MU-V-12, closes automatically upon the presence of a High Pressure Injection actuation signal. (0.5)

2.4 The Decay Heat Closed Cycle cooling water system normally supplies the "B" makeup pump. (0.5)

For the questions below, choose the MOST CORRECT answer:

2.5 One condensate pump is sufficient to supply condensate up to what maximum power level? (.75)

a. 33.3%
b. 40%
c. 50%
d. 75%.

2.6 Upon loss of ICS/NNI "Hand Power," how do the Turbine Bypass Valves fail? (.75)

a. open
b. mid-position
c. as is
d. shut.

- Section 2 Continued on Next Page -

2.7 According to the Diesel Generator procedure (OP-1107-3), which of the following is done to ensure that the diesel generator is lined up for Automatic Standby? (.75)

a. Place the voltage droop switch to the "parallel" position.

b. Set the droop knob on the engine governor at 70 percent.

c. Place the Prelube pump in the "Continuous Run" position.

d. Place the Diesel Generator manual voltage control at the 45 percent setting.

2.8 During shutdown operations on the Decay Heat Removal System, what potential consequence results if DH-V-1, 2 and 3 were opened and the Decay Heat System was operated while the Reactor Building Spray System was being used for recirculation of the BWST? (.75)

a. Injection of NaOH into the RCS.

b. Transfer of Reactor Coolant into the BWST.

c. Overpressurization of the Decay Heat Suction line.

d. Loss of NPSH to the Decay Heat pumps.

Answer the following questions:

2.9 How is core bypass flow minimized for those fuel assemblies that do not contain control rods or neutron sources? (1.0)

2.10 If a loss of Secondary Service Closed Cooling System pump occurs, how is cooling water supplied to the instrument air compressors? (1.5)

- Section 2 Continued on Next Page -

2.11 According to the Turbine Generator Operating Procedure (OP 1106-1) the voltage regulator should always be in automatic operation whenever there is load on the machine. Why is this so? (1.5)

2.12 What flowpath is used to feed a dry OTSG when RCS temperature is >200°F? (Include source of water, major components, and injection point) (2.5)

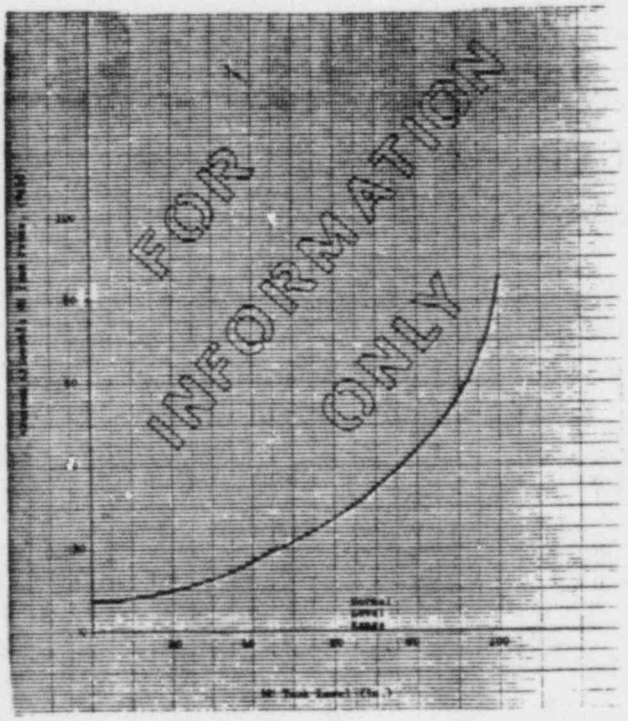
2.13 What three local actions must be taken to gain local manual control of the Emergency Feedwater control valves, EF-V-30A/B? (2.0)

2.14 Show, by making a sketch, the various sources of power to the ICS and NNI Power Bus "ATA." (3.0)

2.15 The following curve taken from the Makeup and Purification procedure (OP 1104-2) defines the maximum allowable MUT pressure vs. tank level.

a. What is the purpose of this limit?

b. Is the allowable area above or below the curve? (2.5)



- Section 2 Continued on Next Page -

2.16 Under what two (2) conditions will the standby Intermediate Closed Cooling pump start? (1.5)

2.17 Make a basic sketch of the Engineered Safeguards Actuation System showing the relation between the bistable cabinets, the relay cabinets and the actuation cabinets. (Note: It is not necessary to show the individual sensors that input into the bistable cabinets) (3.0)

2.18 Name the two types of Rod Position Indication and briefly state how they are sensed. (1.5)

- End of Section 2 -

3.0 INSTRUMENTS AND CONTROLS (25 POINTS)

Label the following statements as TRUE or FALSE:

3.1 There is no automatic cut off on low level for pressurizer heaters while powered from the ES bus. (0.5)

3.2 The High Pressure Injection "Bypass Reset" push-buttons have no effect when pressure is below the setpoint for the HPI Bypass Bistable. (0.5)

3.3 The letdown isolation valve MU-V-3 is automatically reset after a Reactor Trip Reactor Building Isolation, and may be reopened prior to defeating the Reactor Trip R.B. Isolation signal. (0.5)

3.4 If actuated, the LPI and 4 PSI actuations must be bypassed prior to bypassing HPI. (0.5)

3.5 When RB pressure is greater than 4 psi, then no more than four of the six channels of RB Isolation and Cooling can be defeated. (0.5)

For the questions below, choose the MOST CORRECT answer:

3.6 Which of the following will occur when the RCS high point vents are opened? (.75)

a. The RCITS system will not provide accurate/reliable hot leg level or reactor vessel level indication.

b. The RCS pressure indication will continually indicate saturated conditions for Tc.

c. Primary-to-secondary heat transfer will immediately be reestablished.

d. The RCPs by procedure will be running since the interlock trips will have been defeated.

- Section 3 Contiued on Next Page -

3.7 Which one (1) of the following would tend to place the ICS closer to a BTU limit? (.75)

a. A decrease in feedwater flow.
b. An increase in feedwater temperature.
c. An increase in OTSG pressure.
d. An increase in T_{ave}.

Answer the following questions:

3.8 Match the following bypass/switch functions (letter) with the appropriate location (number). (2.0)

a. RPS Channel B Bypass
b. CRD Safety Group Out Limit Bypass
c. PORV Key Switch, RC-RV-2 Automatic Override
d. Pressurizer Heater Lo-Lo Level Cutoff Bypass

1. ICS/NNI Power Monitor Cabinet (Key Switch)
2. CRD System Logic Cabinet No. 3
3. Panel Right Front (PRF)
4. NI/RPS Sub Assembly. B Cabinet No. 2.
5. CRD System Logic Cabinet No. 2 (Relay Room)
6. Center Console (CC) (Key Switch)

3.9 How will rapid RCS depressurization (example: 2155 to ~~600~~ 1555 psig in several minutes) effect pressurizer level indication? Why? (1.5)

3.10 The following condition exists during a plant startup: the startup Feedwater valves are in automatic and about 90% open, the Main Feedwater valves are in automatic and are just beginning to open, the running Main Feedwater pump is in manual with Feedwater valve Delta P being maintained at 70 to 80 psid. Describe how you would place the Feedwater pump turbine in automatic, and how the Main Feedwater valves respond during this operation. (2.5)

3.11 Give four automatic functions of the turbine bypass valves. (2.0)

3.12 What two (2) conditions will result in the automatic de-energizing of the Source Range detector? (1.5)

- Section 3 Contiued on Next Page -

3.13 Given that the Source Range starts at 0.1 CPS and ends at 10^6 CPS and that the Intermediate Range starts at 10^{-11} amps and ends at 10^{-3} amps:

a. Sketch the amount of overlap expected between the Intermediate Range and the Source Range. (1.5)

b. Show what power level on the Intermediate Range corresponds with 1%, 10% and 100% FP. (1.5)

3.14 Which four (4) RPS trip signals are bypassed in the shutdown bypass position? (2.0)

3.15 What three (3) other ICS signals are transferable by individual toggle switches in the "A" RPS cabinet? (1.5)

3.16 What three (3) interlocks are associated with the "Auxiliary and Fuel Handling Building Exhaust Duct" monitor, RM-A8. (1.5)

3.17 With the use of the ICS Figure supplied at the end of this exam, describe in detail how the ICS would respond if the input from the Nuclear Instrumentation (NIs) failed high (max output). Assume 100% power operation with all systems in their normal automatic lineup and no operator action. Take your discussion to the final steady state situation or until a reactor trip occurs, whichever comes first. (3.5)

- End of Section 3 -

4.0 PROCEDURES NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (25 POINTS)

Label the following statements as TRUE or FALSE:

4.1 The "operator at the controls" may be assigned secondary responsibilities (i.e., switching and tagging) provided the plant is in a cold shutdown or refueling mode and a CRO trainee is available to monitor the console. (0.5)

4.2 CAUTION tags, DO-NOT-OPERATE tags, and Instrument OUT-OF-SERVICE stickers may be used interchangeably to indicate equipment status. (0.5)

4.3 On a loss of the "A" DC distribution system, the DC tie switches must be closed to re-energize the "A" system from the "B" side. (0.5)

4.4 If a total loss of the secondary River Water System has occurred, the Nuclear River Water System may be cross-connected with the Secondary Service River Water System to allow continued reactor operation. (0.5)

For the questions below, choose the MOST CORRECT answer:

4.5 According to Emergency Plan Implementing Procedure 1004.10 (Onsite/Offsite Radiological Monitoring), above what airborne radioactivity level should respiratory protection be used?

a. 1E-9 Ci/cc
b. 1E+9 µCi/cc
c. 1E-9 µCi/cc
d. 1E+9 µµCi/cc (.75)

- Section 4 Continued on Next Page -

4.6 Which of the following would indicate that the tube leak was in the "B" OTSG?

a. "A" OTSG has a higher level than the "B" OTSG.

b. "A" OTSG has a higher feed rate than the "B" OTSG.

c. "A" OTSG has a higher I-133 and Cs-137 sample result than the "B" OTSG.

d. "A" OTSG steam line radiation level is higher than "B" OTSG steam line line radiation level. (.75)

Answer the following questions:

4.7 Problems encountered during surveillance testing are recorded on an "Exception and Deficiency (E&D) Sheet." Explain the difference between an "Exception" and a "Deficiency." (2.0)

4.8 In what order should the following fire fighting equipment be used for combatting an electrical fire?

a. CO_2 extinguisher
b. Halon extinguisher
c. Water in the form of FOG. (1.0)

4.9 According to EP 1202-37 (Cooldown from Outside the Control Room), what immediate manual actions should the operator complete before evacuating the control room. (4.0)

- Section 4 Continued on Next Page -

4.10 According to AP-1012 (Shift Relief and Log Entries) match the action that the Control Room Operator must take (letter) with the document type (number). (NOTE: There can be more than one number per letter.) (2.5)

a. Prior to assuming the shift, the CRO must review this document.

b. The oncoming CRO must initial this document.

c. This document must be reviewed by the CRO during each shift.

d. The CRO signs this document prior to assuming the shift duty.

1. Active Tagging Application Book
2. Locked Valve Log
3. Outstanding Surveillance Schedule
4. ES Checklist
5. Revision Review Book
6. TCN and STP Books
7. Operations Memo Book
8. Control Room Log.

4.11 What actions should be taken if there is a #1 seal leak off flow of 8 gpm and a #1 seal outlet temperature of 210°F on RCP 1A? Assume that the reactor is at 100% power steady state. (2.0)

4.12 According the Reactor/Turbine Trip Abnormal Transient Procedure (OP-1210-1), what actions, if any, should be taken after a Reactor/Turbine trip in each of the following situations.

a. Offsite power is lost and only one DG starts. (1.5)

b. Pressurizer level is being maintained at 120 inches and makeup tank level is 60 inches. (0.5)

c. Generator/field breaker remains closed. (1.0)

- Section 4 Continued on Next Page -

4.13 Explain the procedure to be followed by the operating shift upon discovery that a control room instrument indication is out of calibration or unreliable. (2.0)

4.14 Which of the following are addressed by your Technical Specifications. Answer YES if the item is addressed and NO if it is not addressed. (3.0)

a. Source Range NIs during startup
b. Core Flood tank level
d. Diesel Generators
e. Plant Computer
f. Incore nuclear detectors
g. Turbine-Generator speed control
h. RCP Seal Injection system
i. OTSG chemistry (Cl, Fl,O_2)
j. Containment air temperature

4.15 State the three (3) High Pressure Injection (HPI) Initiation Criteria as given in the Abnormal Transients Rules, Guides, and Graphs procedure, (OP-1210-10). (2.0)

- End of Section 4 -

- END OF EXAM -

EQUATION SHEET

Where $\dot{m}_1 = \dot{m}_2$

$(\text{density})_1(\text{velocity})_1(\text{area})_1 = (\text{density})_2(\text{velocity})_2(\text{area})_2$

$KE = \frac{mv^2}{2}$ $\quad PE = mgh$ $\quad PE_1+KE_1+P_1V_1 = PE_2+KE_2+P_2V_2$ where V = specific volume, P = Pressure

$Q = \dot{m}c_p(T_{out}-T_{in})$ $\quad Q = UA\,(T_{ave}-T_{stm})$ $\quad Q = \dot{m}(h_1-h_2)$

$P = P_0 10^{sur(t)}$ $\quad P = P_0 e^{t/T}$ $\quad SUR = \frac{26.06}{T}$ $\quad T = \frac{(B-p)t}{(p)}$

$\text{delta } K = (K_{eff}-1)/K_{eff}$ $\quad CR_1(1-K_{eff1}) = CR_2(1-K_{eff2})$

$M = \frac{(1-K_{eff1})}{(1-K_{eff2})}$ $\quad SDM = \frac{(1-K_{eff}) \times 100\%}{K_{eff}}$

$\text{decay constant} = \frac{\ln(2)}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ $\quad A = A_0 e^{-(\text{decay constant})x(t)}$

Water Parameters

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

Density = 62.4 lbm/ft^3

Density = 1 gm/cm^3
Heat of Vaporization = 970 Btu/lbm
Heat of Fusion = 144 Btu/lbm
1 Atm = 14.7 psia = 29.9 in Hg

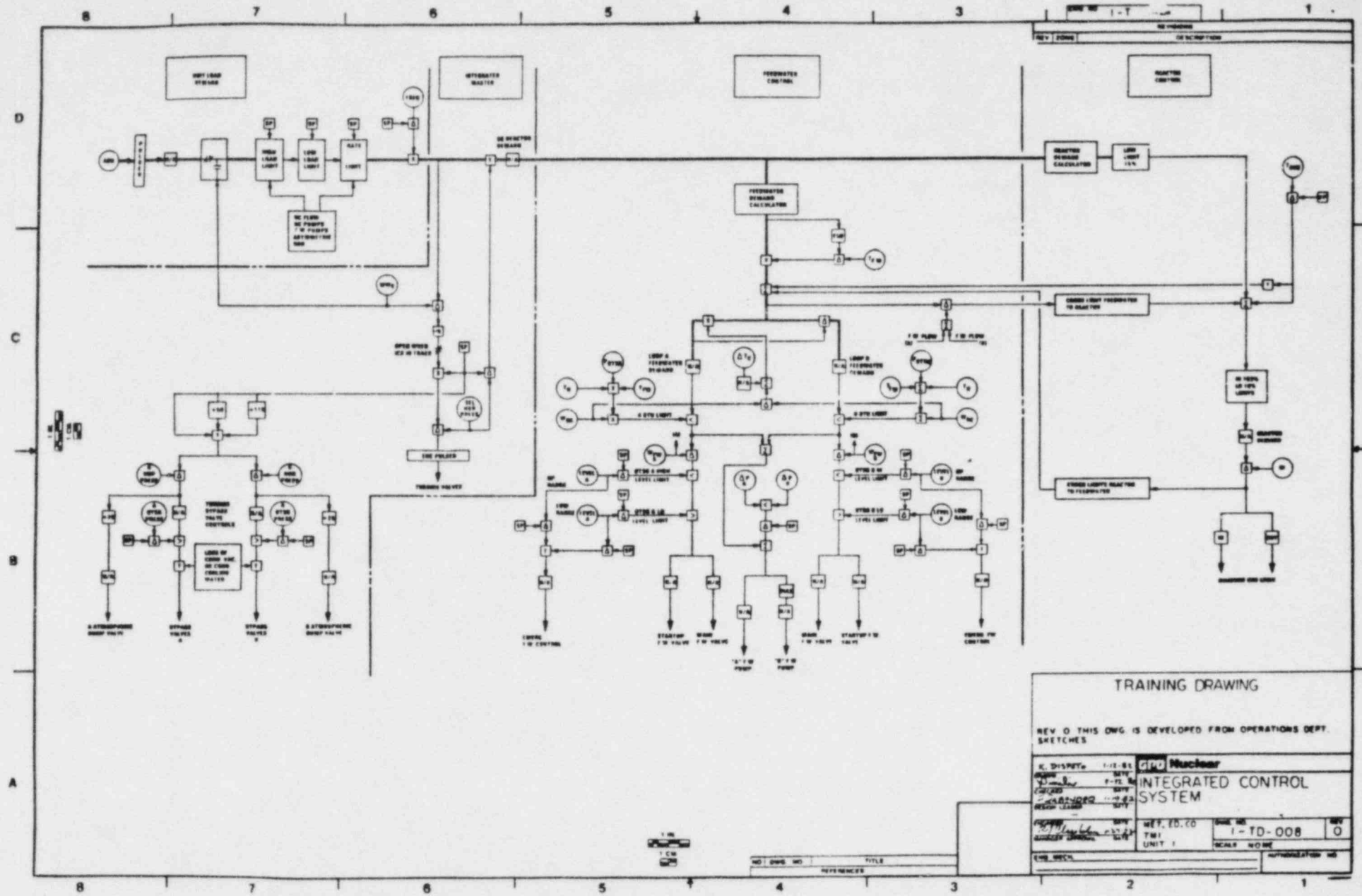
Miscellaneous Conversions

1 Curie = 3.7×10^{10} dps
1 kg = 2.21 lbs

1 hp = 2.54×10^3 Btu/hr

1 Mw = 3.41×10^6 Btu/hr

1 inch = 2.54 centimeters
Degrees F = (1.8) x (Degrees C) + 32
1 Btu = 778 ft-lbf
g = 32.174 $ft\text{-}lbm/lbf\text{-}sec^2$


TRAINING DRAWING
REV 0 THIS DWG IS DEVELOPED FROM OPERATIONS DEPT. SKETCHES
GPU Nuclear
INTEGRATED CONTROL SYSTEM
W.E.F. 10.20
TMI UNIT 1
1 - TD - 008
0
SCALE NONE

Reviewed W/Ops 4/18/85
4/18/85

TMI-1 ANSWER KEY

1.0 PRINCIPLES OF NUCLEAR POWER PLANT OPERATION THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW (25 POINTS)

1.1 True

Ref: Abn Trans Proc, p. 11.0
1210-5

1.2 True

Ref: Abn Trans Proc, p. 10
1210-10

1.3 True

Ref: Lesson Plan 1, p. 85, Heat Transfer Fundamentals

1.4 False - reaction starts at approx. 1800°F; the 2200°F limit is to keep reaction to less than 1% of available zircaloy. (Reason not required.)

Lesson Plan 2, p. 6, Large PWR Core Heat Transfer

1.5 True.

Ref: TMI Radiation Protection Program, p. 205

1.6 False - it is due to decay of fission fragments (reason not required).

Ref: ATTS, Vol 3, Heat and Fluid Power, p.203

1.7 c. 70-150 psi/hr

Ref: EP 1202.2A, p. 5

1.8 c. - Its never lost (reason not required).

Ref: Small Break LOCA Lesson Plan, p. 12.

1.9 d. a. want them far from SR
~~b. only 1 is regenerative~~
c. there are intrinsic neutron sources; safety is issue not ability to S/Ue. sources are on outer edges
or
b. 2 regenerative sources

(reasons not required)

Ref: Reactor Theory Lesson Plan, p. 6

1.10 c. they should be open (reason not required).

Ref: ATTS, Vol. 3, Heat and Fluid Power, p. 20-21

1.11 The reactor power must be increased (0.75) to burnout xenon (0.75).

Ref: AP-1203-1, p. 4

1.12 To allow detector output signals to reach steady state. The Rhodium has a half-life in the in-core which requires time to establish equilibrium.

Ref: Abn Proc 1203-7, p. 2

1.13 $K_1 = \frac{1}{1+SDM_1} = \frac{1}{1+.04} = .962$

$K_2 = \frac{1}{1+SDM_2} = \frac{1}{1+.03} = .971$

$\frac{CR_1}{CR_2} \neq \frac{1-K_2}{1-K_1} \neq \frac{1-.971}{1-.962}$

$CR_2 = \frac{100}{.763} = 131.03$

1.14 Equilibrium iodine is proportional to power, while equilibrium xenon is not. Therefore, you have a higher ratio of I to Xe at higher power levels. The greater the I to Xe ratio, the longer it takes for sufficient I to decay to Xe such that an equilibrium production and decay of Xe is occurring (i.e., the peak).

Ref: TMI Reactor Theory Lesson Plan, p. 49, 54, 59

1.15 No, SUR is non-linear with reactivity. More reactivity is necessary to go from + ½ DPM to 0 DPM than from +1 DPM to + ½ DPM.

1.16 Disassociation of or breakdown of chemicals used for secondary water treatment.

(1/2 credit given if states liberation of dissolved feedwater gases in the steam generator.)

Ref: ATTS,Vol 3, Heat and Fluid Power, p. 46

1.17 Detector 3 was initially placed too far from the source. As a result its initial countrate was quite low and probably unreliable. In addition, the effect of moderator displacement causes the detector to grossly overestimate the effect of the first two increments. After the third increment of fuel is added, however, this detector will begin to give fairly reliable results since it sees the core very well and the source-core detector geometry is no longer being altered appreciably.

Ref: ATTS, Vol 2, Reactor Theory, p. 127 and 128

1.18 a. Saturated
b. Subcooled
c. Superheated
d. Saturated
e. superheated
f. Saturated

Ref: Steam Tables.

1.19 a. T_h and Delta T will decrease, T_c will increase. This results from the energy balance $Q=M\ C_p\ (T_h - T_c)$.

b. Feed flow will be adjusted by the ICS to maintain T_c's equal. The OTSG in the loop that gained flow will be increased, the feed flow int the other OTSG will be decreased with the final feed flows balanced between the two OTSGs.

ANSWER KEY

2.0 PLANT DESIGN, INCLUDING SAFETY AND EMERGENCY SYSTEMS (25 POINTS)

2.1 False. It is a "two way" limit.

Ref: OP 1106-2, p. 6, p. 20

2.2 True

Ref: OP 1106-2, p. 31

2.3 False

Ref: OP 1105-3, p. 18

2.4 False

Ref: OP 1104-2, p. 8

2.5 c. 50%

Ref: OP 1106-2, p. 8

2.6 d. Shut

Ref: OP 1105-4, p. 5

2.7 d. Place the Diesel Generator manual voltage control at the 45 percent setting.

Ref: OP 1107-3, p. 19, 20, 18, 17

2.8 b. Transfer of reactor coolant to the BWST

Ref: OP 1104-4, p. 10

2.9 ~~Usually an~~ NOT HIGH, orifice rod assembly (ORA) ~~is installed in~~ HAS BEEN REMOVED FROM the guide tube.

Ref: TMI Cycle 5 Reload Report, p. 6-1

2.10 Four valves open (SC-V57A+B/SC-V58A+B - #'s not needed) supplying cooling

water from the fire service system.

Ref: Abn. Proc. 1203-21, p. 2

2.11 Damage to the transformer would result if a trip were to occur.

Ref: OP 1106-1, p. 8

2.12 Hotwell, condensate pumps, condensate polishing demineralizer, gland seal condenser, condensate booster pumps, 12th-6th stage low pressure heaters, 2nd-4th stage high pressure heaters, feedwater block valve, feedwater control valve, main feedwater nozzles, (need five of the eight components for full credit). Main feedwater pumps not

Ref: OP 1210-10, C-302-81, CC-302-101

2.13 1. Align holes and insert pin.

2. Position Auto-Manual switch on controller box to "Manual."

3. Open equalizing valve located on outside of the diaphragm.

Ref: OP 1106-6, Enclosuree III, p. 25

2.14 Figure on p. 33 of OP 1107-2 (Attached) 3 sources required:

Ref: OP 1107-2, p. 33 and E-206-051

VBA
TRA via auto transfer switch
TRA via manual transfer switch

2.15 a. It assures that gas entrainment into the MU pumps will NOT occur in the event of Emergency Injection without isolating the MUT. not

b. Below the curve.

Ref: OP 1104-2, p. 4

2.16 Low ICCW flow and if the running pump's circuit breaker trips.

Ref: ICCW Lesson Plan

2.17 See the figure ~~immediately~~ following.

Ref: I-TD-012

3 channels
Each channel - one red, one green
2 actuation channels, 2 out of 3 logic

2.18 Absolute and Relative.

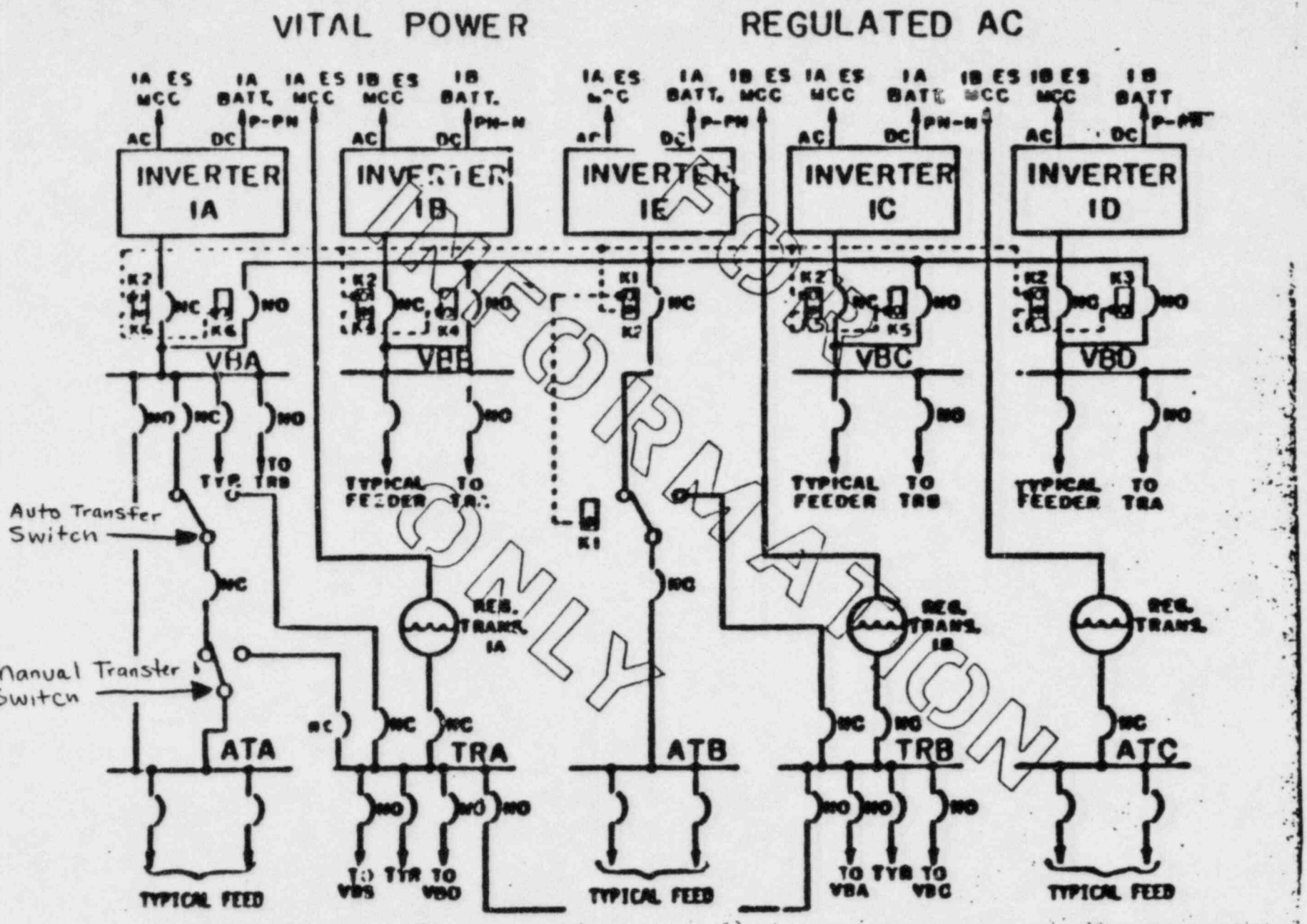
not

Absolute is sensed by reed switches

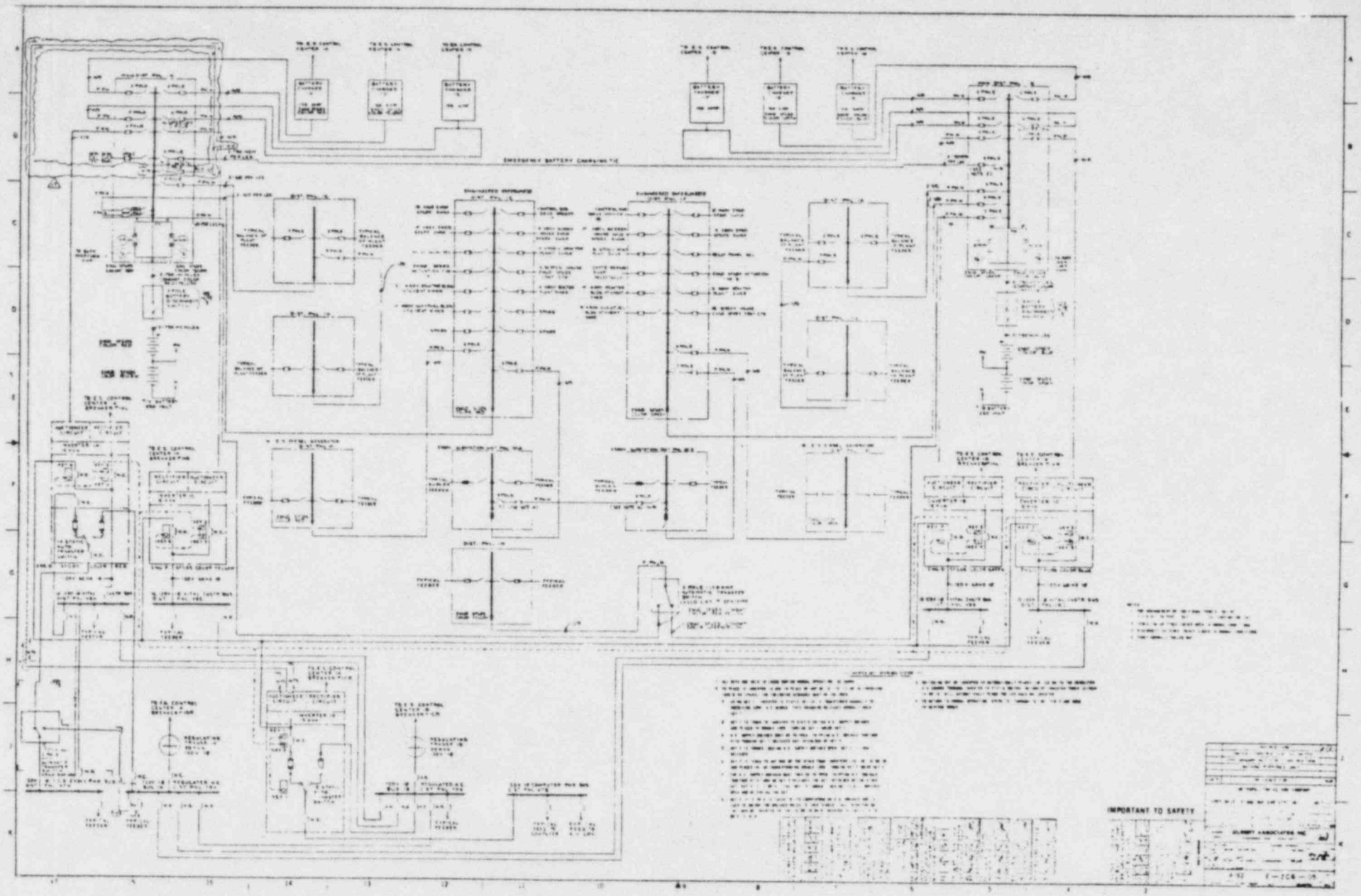
Relative is sensed by a stepping motor in parallel with the CRDM motor phases.

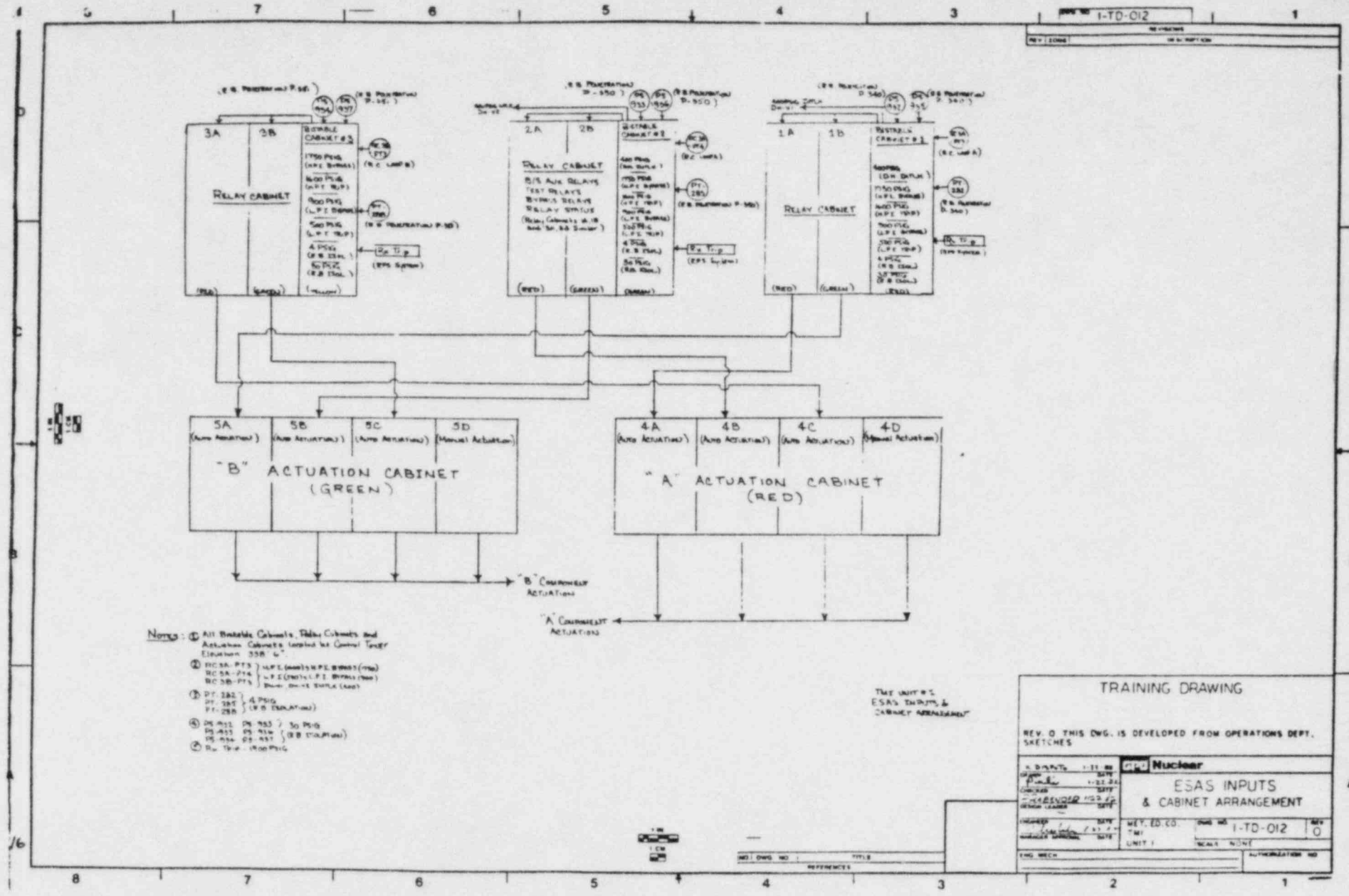
Ref: B+W Videotape training on CRD sys.

FOR USE IN UNIT I ONLY



FOR USE IN UNIT I ONLY




1-TD-012
3A
3B
RELAY CABINET
2A
2B
RELAY CABINET
B/S AUX RELAYS
TEST RELAYS
BYPASS RELAYS
RELAY STATUS
1A
1B
RELAY CABINET
5A (Auto Actuation)
5B (Auto Actuation)
5C (Auto Actuation)
5D (Manual Actuation)
"B" ACTUATION CABINET (GREEN)
4A (Auto Actuation)
4B (Auto Actuation)
4C (Auto Actuation)
4D (Manual Actuation)
"A" ACTUATION CABINET (RED)
"B" Component Actuation
"A" Component Actuation
Notes :
All Bistable Cabinets, Trip Cabinets and Actuation Cabinets located in Control Tower Elevation 358' 6"
TRAINING DRAWING
REV. 0 THIS DWG. IS DEVELOPED FROM OPERATIONS DEPT. SKETCHES
Nuclear
ESAS INPUTS & CABINET ARRANGEMENT
1-TD-012
0

ANSWER KEY

3.0 INSTRUMENTS AND CONTROLS (25 POINTS)

3.1 True

Ref: EP-1202-29, p. 18

3.2 False

Ref: Drawing 1-TD-010 or OP 1105-3, p. 2

3.3 True

Ref: OP 1105-3, p. 12

3.4 True

Ref: OP 1105-3, p. 13

3.5 True

Ref: OP 1105-3, p. 14, Dwg 1-TD-01

3.6 a

Ref: Abn Trans Proc 1210-8, p. 3

3.7 c. An increase in OTSG pressure.

Ref: ICS training material, Fig IV - 4

3.8 a. 4
b. 2
c. 6
d. 1

Ref: AP 1013, Encl. 1

3.9 It will indicate erroneously high offgassing and water ejection from the reference leg. ~~(1.0)~~

Accept boiling in reference leg, also. ~~(0.5)~~

Ref: Abn Trans Proc 1210-10, p. 8

3.10 Slowly lower the operating Feedwater pump speed with its ICS hand/auto controller. FW-V-17A and B demand will increase and they should open maintaining a fairly constant Feedwater flow. When Feedwater valve Delta P is about 35 psid, check that the measured variable position shows no error, then place the Feedwater turbine in automatic.

Ref: OP 1106-3, p. 16

3.11 a. When <15% power they maintain 895 psig in the main steam header.

b. Provide a high pressure relief if steam generator pressure exceeds 960 psig.

c. Provide an independent high pressure relief that operates proportional to OTSG pressure when $\geq$1027 psig.

d. Provides pressure control at 1010 psig after a trip.

Ref: OP 1106-5, p. 4, 5

3.12 When <u>both</u> IR channels $\geq 10^{-9}$ amps

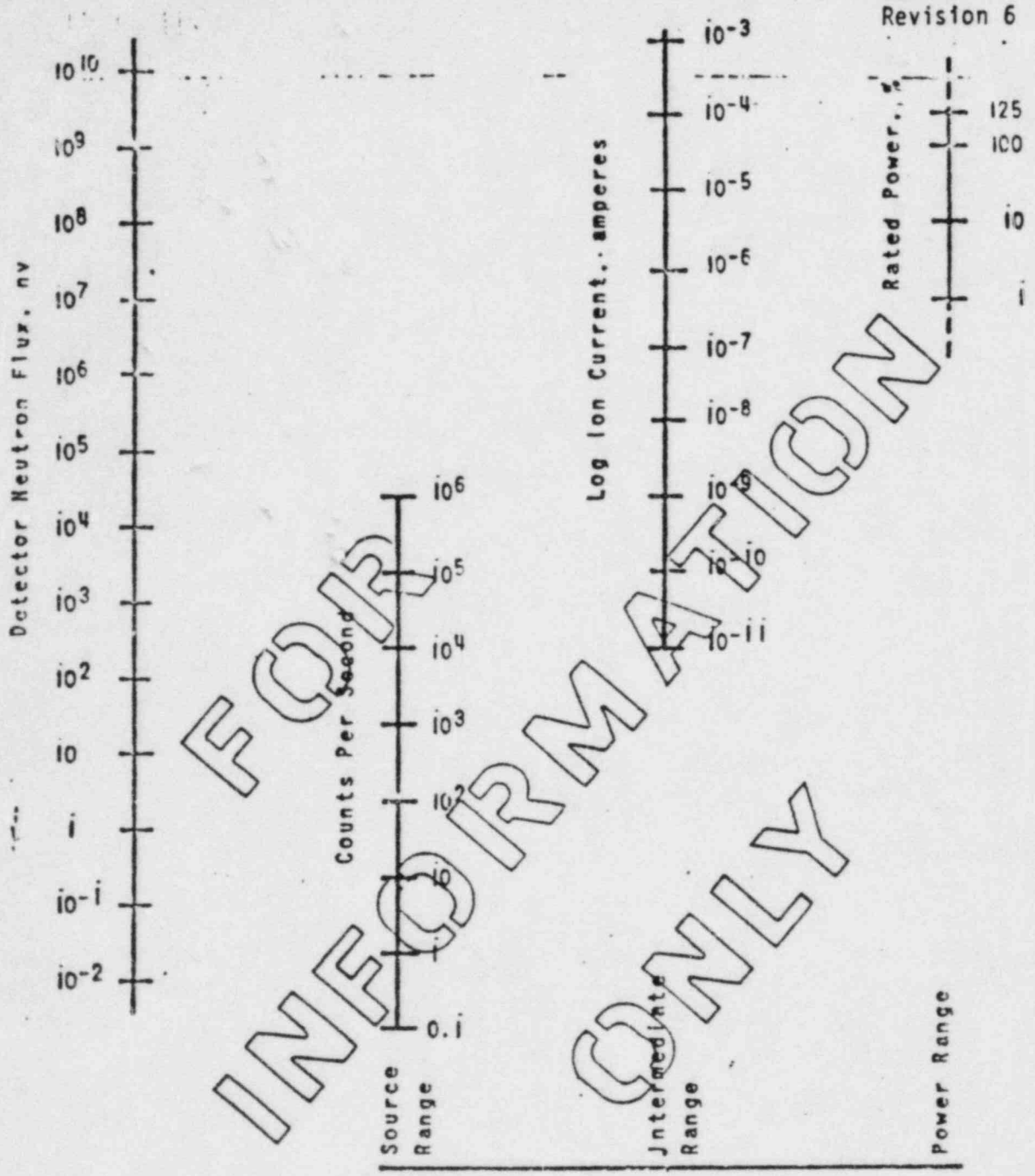
or

when NI-5 or 6 and 7 or 8 are $\geq$10% FP.

Ref: OP 1105-1, p. 5

3.13 See Figure 1 of OP-1105-1

Ref: OP 1105-1, P. 11, Figure 1



FOR INFORMATION ONLY

NUCLEAR INSTRUMENTATION FLUX RANGES
THREE MILE ISLAND NUCLEAR STATION UNIT 1

FIGURE 1

3.14 Nuclear overpower based on flow and imbalance, percent maximum.

Nuclear overpower based on pump monitors, percent maximum.

Low Reactor Coolant System pressure, psig minimum.

Variable low Reactor Coolant System pressure, psig minimum.

Ref: OP 1105-2, p. 5

3.15 RC flow, RC pressure, and neutron flux

Ref: OP 1105-2, p. 15

3.16 The Aux Building vent damper and supply fan.

The Fuel Handling Building vent damper and supply fan.

The waste gas discharge valve (WDG-V47).

Ref: OP 1105-8, p. 56, Figure 5.6

3.17 The ICS goes into "Track" due to the crosslimits. Rods will start driving in. Feed flow will start increasing to get within 5% of indicated Reactor Power. Reactor pressure and temperature and steam superheat will start decreasing. RCS low pressure will cause the Reactor to trip.

ANSWER KEY

4.0 PROCEDURES: NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (25 POINTS)

4.1 True

Ref: AP-1028, p. 4

4.2 False - Caution tags not to be used in place of instrument out-of-service tags (reason not required).

Ref: AP-1037, p. 2

4.3 False - Ties must be left open to preclude losing both sides (reason not required)

Ref: EP 1202-9A, p. 3

4.4 False - cannot cross-connect unless reactor shut down (reason not required).

Ref: An. Proc. 1203-19, p. 4

4.5 c - other values are ridiculously high

Ref: EPIP-1004.10, p. 1

4.6 b

Ref: Abn. Trans. Proc. 1210-5, p. 1

4.7 A deficiency is defined as an equipment problem or malfunction encountered during surveillance testing, or a test not completed by the late performance date.

An exception is defined as a change in the procedure which does not alter the scope or intent of the procedure.

Ref: AP-1001A, p. 12, 17

4.8 b. Halon
a. CO_2
c. Water (last resort)

Ref: EP 1202-31, p. 9

4.9 a. Depress REACTOR TRIP pushbutton on console CC.

b. Verify turbine trip.

c. Start the motor driven EMERGENCY FEED PUMPS from console CL and CC.

d. Depress 1A FEEDPUMP TURBINE and 1B FEEDPUMP TURBINE TRIP push buttons on CL (auto starts steam driven EFP).

e. Reduce number of REACTOR COOLANT PUMPS to one per loop.

f. Cross-tie the Nuclear and Turbine Plant channels of the M and I sound powered phones in the I and C Foreman's office or in the rear of Panel PLF

g. Start emergency boration depending on Emergency Source Tank either by:

1. Open MU-V51, set max strokes on the strokes counters and start both boric acid pumps, or

2. Set max batch size and pre-shutdown on batch controller, clear controller, go to start, open MU-V10, insure MU-V9 is closed, open WDL-V61 have aux. operator at LWDS Panel open WDL-V49(50) and close WDL-V93(94) and start WDL-P13A(B) if not running.

h. Maintain makeup pump in operation and pressurizer level and seal injection control automatic.

Ref: EP-1201-37, p. 1, 2

4.10 a. 4-8 .25 pts each
b. 4
c. 1-3
d. 8

Ref: AP-102, p. 13

4.11 Close the seal leakoff valve, reduce power to 75% and secure the pump.

Ref: OP 1203-16, p. 1

4.12 a. Verify one DG starts and loads [0.4], Restore makeup [0.3] seal injection [0.3] and EFW [0.3], Refer to the Station Blackout procedure [0.2].

b. No action required.

c. Manually trip the generator output breakers and the field breakers.

Ref: OP 1210-1 pg 1, and 2.

4.13 SS/SF/CRO are responsible for identifying and logging instrument OOS, assuring that a work request for repair is submitted, and placing a yellow OOS tag or sticker on instrument.

Ref: AP 1036

4.14

a. Yes	f. Yes
b. Yes	g. No
~~c. No~~	h. No
d. Yes	i. No
e. No	j. Yes

Reference: Technical Specifications

4.15 a. 1600 psig ESAS has auto initiated or

b. Subcooling margin is less than 25 Deg F or

c. Neither OTSG is available as a heat sink