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

EXAMINATION REPORT NO. 85-15 (OL)

FACILITY DOCKET NO. 50-423

CONSTRUCTION PERMIT NO. CPPR-113

LICENSEE: Northeast Nuclear Energy Company
P. O. Box 270
Hartford, Connecticut 06141

FACILITY: Millstone 3

EXAMINATION DATES: May 14-17, 1985 and May 21-23, 1985

CHIEF EXAMINER: D. Ruscitto — 7/30/85
D. Ruscitto, Examiner — Date

REVIEWED BY: D. Johnson — 7/30/85
D. Johnson, Lead Examiner — Date

REVIEWED BY: R. Keller — 7/31/85
R. Keller, Chief, Project Section 1C — Date

APPROVED BY: H. B. Kister — 8/2/85
H. Kister, Chief, Project Branch No. 1 — Date

SUMMARY: Oral, written and simulator examinations were given to sixteen Senior Reactor Operator (SRO) and five Reactor Operator (RO) candidates. 2 RO and 9 SRO candidates passed all portions of the examination and will be issued licenses. 3 RO and 7 SRO candidates failed one or more portions of the examination and their license applications were denied. Four candidates were identified as performing significantly above average on the oral/simulator portions of the examination.

REPORT DETAILS

TYPE OF EXAMS: Initial

EXAM RESULTS:

	RO Pass/Fail	SRO Pass/Fail
Written Exam	3/2	16/0
Oral Exam	4/1	15/1
Simulator Exam	3/2	9/7
Overall	2/3	9/7

1. CHIEF EXAMINER AT SITE: D. Ruscitto

2. OTHER EXAMINERS: D. Johnson, NRC
W. Hemming, EG&G, Idaho
B. Picker, EG&G, Idaho
P. Isaksen, EG&G, Idaho
R. Sailor, EG&G, Idaho

3. SUMMARY OF GENERIC DEFICIENCIES FROM ORAL AND SIMULATOR EXAMS

Major deficiencies were noted in the following areas:

Ability to diagnose casualties
Utilization of the radiation monitoring system
Effective Utilization of Emergency Procedures
Shift Crew Teamwork and Communications
Minor deficiencies were noted in the use of portable radiation monitoring instruments

4. SUMMARY OF GENERIC DEFICIENCIES NOTED FROM WRITTEN EXAMS

RO Exam (5 Candidates)

The following were areas of minor weakness:

RHR Suction Valve Interlocks
RCP Cooling Flow Paths
Effect of EGLS LOP and SI Resets
Power Range Instrument

SRO Exam (16 Candidates)

The following were areas of minor weakness:

Fuel Temperature Coefficients
Effects of an Impulse Pressure Channel Failure
Station Bypass and Jumper Control Procedure

5. INTERFACE WITH PLANT STAFF DURING EXAM PERIOD

Liaison with plant staff was good and the simulator instructors were helpful in scenario review and modifications during the course of several scenarios, which facilitated the examination process.

6. PERSONNEL PRESENT AT EXIT INTERVIEW

NRC Personnel

D. Johnson, Lead Reactor Engineer (Examiner)
D. Ruscitto, Reactor Engineer (Examiner)
T. Rebelowski, Senior Resident Inspector

Facility Personnel

R. Test, Director, Nuclear Training
J. Black, Simulator Project Manager
J. Crockett, Unit Superintendent
W. Landon, Simulator Program Supervisor
T. Harvey, Senior Instructor
L. Allen, Simulator Instructor
M. Hall, Operator Instructor

7. SUMMARY OF NRC COMMENTS AT EXIT INTERVIEW

Generic deficiencies during oral/simulator exams and interface with plant staff were summarized. Preliminary results of thirteen candidates clearly passing and eight candidates being marginal were presented. Four candidates were identified as being clearly above average on their performance on the oral and simulator portions of the examination.

8. EXAMINATION REVIEW

At the conclusion of the written examinations, the examiners met with the following licensee personnel to review the exam and answer keys to identify any inappropriate questions relative to plant specific design and to ensure that the questions will elicit the answers in the key and that they reflect the most current plant conditions.

T. Harvey	W. Mihalovits
J. Crockett	T. McDonald
T. Hall	W. Potter
M. Levitan	

Attachments:
1. Written Examinations and Answer Keys (SRO/RO)
2. Comments on Written Examinations and Resolution

ATTACHMENT 2

RO Exam Comments and Resolution

Question/Answer	Comment
2.04a	Key changed to read "Allows manual control of loads once SI is reset" since reset of SI cannot be assumed the way question is asked.
2.05a	Reworded answer to include the concept of maintaining boron concentration low enough to prevent crystallization at room temperature.
2.07d	Added additional correct answer per MCB.
2.08	Deleted "4 flow indicators with orifices" since these are local indications only and not used for normal control room operations.
3.01	Two answers are acceptable based on which reference is used. Training material is not consistent. Topic 8, Lesson 4, pages 45-46 states that the plant will trip. Simulator transients indicate that it will not trip. Either will be accepted with an explanation.
3.05	The interlocks on RCS cold leg loop isolation valves have been removed from the system, however, the training material has not been updated. This question was replaced with the question attached to the Master Exam.
4.01	Since these Tech Spec valves are not finalized, Part A is deleted and Part B graded according to answer given for Part A.
4.02	Expanded acceptable bands for assumed values to be more realistic in the calculation.
4.04	Comment that verbatim repeat of CAUTIONS from EOP should not be required is not accepted. Candidates are expected to know these and their bases per NUREG-1021. Added "Cooling head and starting RCPs" as an acceptable partial answer.
4.07	Comment that this is a memorized step is not accepted. This knowledge is well within the level required of an RO.

Question/Answer	Comment
4.09b	Comment that this is a memorization of a caution step is correct. This is within the scope of RO knowledge.
4.09c	Deleted due to possible confused wording.

SRO Exam Comments and Resolution

Question/Answer	Comment
5.01	Comment that one answer only is correct is not accepted. Question refers to fuel temperature. The effects of clad creep and fission gas buildup affect fuel temperature.
5.04c	Comment that there are other answers is not accepted since the axial flux redistribution phenomenon is temperature related, not design, rod height or power dependent.
6.01c	Comment that train dependance is not important is not accepted. This is an area where specific operator knowledge is required.
6.02	See comment for Question 3.05.
6.03a	See comment for Question 6.01c.
6.04a	Added additional correct answer based on reference supplied by DWG No. 12179-LSK-24-9.3J and 12179-LSK-24-9.2D.
6.09c	Correct answer is "To maintain proper pH in containment sump" per T.S. Bases 3/4.6.2.3. Training material provided is not consistent with T.S. and should be modified. Either answer accepted.
7.01d 7.02d 7.03c, e 7.04a	Comments concerning memorization is not accepted. These are areas of knowledge with significant importance for an SRO.
Answer 7.04b	Added additional answers of "Core ΔT, S/G pressure/temperature" as is good engineering practice.

Question/Answer	Comment
7.04d	Added additional correct answer of "RWLMS < 100%" per F-0.6.
7.04e	Auxiliary spray flow must not be discussed for full credit as it is implied by charging flow adjustment.
7.07b	Deleted as too specific to HP work.

MASTER COPY

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: MILLSTONE 3

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 85/05/14

EXAMINER: HEMMING, W.

APPLICANT: ______________________

INSTRUCTIONS TO APPLICANT:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses 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	APPLICANT'S SCORE	% OF CATEGORY VALUE		CATEGORY
25.00	~~25.00~~ 25.12	________	________	1.	PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	~~25.00~~ 25.12	________	________	2.	PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
25.00	~~25.00~~ 25.12	________	________	3.	INSTRUMENTS AND CONTROLS
~~25.00~~ 24.5	~~25.00~~ 24.62	________	________	4.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
100.00	100.00	________	________		TOTALS

FINAL GRADE ________________%

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

____
APPLICANT'S SIGNATURE

QUESTION 1.01 (2.00)

After calculating an Estimated Critical Position for startup it is necessary to dilute 200 ppm boron. Initially source range counts are 40 cps and 45 cps. After diluting 100 ppm boron, source range counts indicate 85 cps and 70 cps. Should you continue the dilution? EXPLAIN. (2.0)

QUESTION 1.02 (3.00)

a. Is the reactivity value of 100% equilibrium Xenon double the reactivity value of 50% equilibrium Xenon. EXPLAIN. (1.5)

b. Which of the below takes the reactor longer to achieve?

1. 25% equilibrium xenon.
   OR
2. 50% equilibrium Xenon.

EXPLAIN YOUR ANSWER. (1.5)

QUESTION 1.03 (3.00)

How does control rod worth vary with each of the following? EXPLAIN your answer.

a. With its radial position in the core. (1.0)

b. The RC system boron concentration is increased. (1.0)

c. The moderator temperature increases. (1.0)

QUESTION 1.04 (3.00)

During a startup the reactor is subcritical at 3000 CPS on the Source Range Instruments when a steam dump valve fails open.

a. EXPLAIN what happens to reactor power and Tave. Continue your explanation until stable conditions are reached with no operator action. (Assume the reactor is undermoderated, at BOL and no reactor trip occurs.) (1.5)

b. Assume the same transient as above occurs at EOL. EXPLAIN any differences in the power/Tave response and final stable conditions as a result of the increased burnup. (1.5)

QUESTION 1.05 (1.00)

The TOTAL POWER COEFFICIENT (pcm/%power) at BOL is LESS NEGATIVE THAN the total power coefficient at EOL. Briefly EXPLAIN why. (1.0)

QUESTION 1.06 (1.50)

a. Explain why fission product gas build-up in the gap between the fuel and clad causes Doppler (power only) Coefficient to become more negative over the life of the core. (1.0)

b. Does the effect of "clad creep" cause the Doppler (power only) Coefficient to become MORE or LESS negative, over the life of the core? (0.5)

QUESTION 1.07 (3.00)

a. Of the coefficients that contribute to the power defect, which coefficient contributes most to the change of power defect over core life? EXPLAIN. (1.0)

b. Explain why power defect is desireable for reactor operation at power. (1.0)

c. Which of the reactivity coefficients that contribute to power defect act first to affect reactivity on a sudden power change due to rod movement? EXPLAIN WHY. (1.0)

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.08 (2.50)

a. How and why does an INCREASE in CONDENSATE DEPRESSION effect plant efficiency? (1.5)

b. How does an INCREASE in CONDENSATE DEPRESSION effect the NPSH for the condensate pumps? (1.0)

QUESTION 1.09 (2.50)

a. During natural circulation, explain how it is possible to form a bubble in the reactor vessel head when indications show that the RCS is subcooled? (1.5)

b. How will pressurizer level respond, (INCREASE, DECREASE, or REMAIN THE SAME) if the backup heaters are energized with a bubble in the reactor vessel head? Assume normal pressurizer level and briefly EXPLAIN your answer. (1.0)

QUESTION 1.10 (2.50)

Indicate how the following will affect Unit efficiency (increase, decrease, no change) at a steady state power level: (Consider each case separately.)

a. Absolute condenser pressure changes from 1 psi to 1.25 psi.

b. Total S/G blowdown is changed from 35 gpm to 40 gpm.

c. Condenser hotwell temperature changes from 125 F to 130F.

d. Steam quality changes from 99.8% to 99.7%.

e. Current being drawn by RCP's increases slightly along with a slight change in bus voltage. (2.5)

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.11 (1.00)

Determine if the statement below is correct or incorrect. Defend your answer.

As the temperature difference between the fuel rod surface and the saturation temperature of the coolant (Twall-Tsat) increases, the heat flux across the fuel surface (BTU/hr sq. ft.) increases at a constant linear rate. (1.0)

(***** END OF CATEGORY 01 *****)

QUESTION 2.01 (2.50)

a. Is the flowrate through the RCP #1 seal constant for all plant conditions? EXPLAIN.

b. What determines the differential pressure across #2 RCP seal? (.75)

c. What is/are the flowpath(s) for the #1 RCP seal leakoff during a phase A isolation? (.75)

QUESTION 2.02 (2.00)

a. What are the functions of the Auxiliary Feedwater System. (.75)

b. What is the performance criteria of the Auxiliary Feedwater System during a Station Blackout in order to prevent the RCS pressurizer from going solid. (1.25)

QUESTION 2.03 (2.00)

List THREE support systems used to ensure that the emergency diesel generator will rapid start and load in the design time limit. DESCRIBE how each system accomplishes this task. (DO NOT include administrative or maintenance requirements.) (2.0)

QUESTION 2.04 (3.00)

a. A Safety Injection (SI) with a Loss of Power (LOP) has occurred and the Emergency Generator Load Sequencers (EGLS) have cycled completely. All proper safeguard loads are running. Describe the effect depressing the EGLS LOP RESET has on the EGLS and the operation of the safeguard equipment. (1.5)

b. When will the EGLS respond to an initiating signal after the EGLS LOP RESET is depressed? Be specific. (.75)

c. What action(s) must an operator perform to restore the EGLS to an armed condition, ready to auto initiate? (.75)

(***** CATEGORY 02 CONTINUED ON NEXT PAGE *****)

QUESTION 2.05 (2.00)

a. What will cause the letdown orifice isolation valves (AV 8149 A,B,C) to close with no operator action? (control switch for all the valves in the auto/open position). (1.0)

b. What is the function and purpose of valve PCV 131 (letdown pressure control valve) for each of the below. Be specific.

1. normal operations.
2. solid plant operations. (1.0)

QUESTION 2.06 (2.00)

a. List THREE reasons for maintaining a minimum Pressurizer spray line flow during normal "at power" operations (1.0)

b. What alarm(s) give indication to the operator that minimum spray flow is not being maintained? (0.5)

c. Which RCS loops provide spray flow to the Pressurizer? (0.5)

QUESTION 2.07 (3.00)

a. Describe the difference in flowpaths used for ALTERNATE DILUTE and DILUTE modes of operation in the Reactor Makeup System. (.75)

b. Explain the purpose of designing two different dilution paths into the Reactor Makeup System. (.75)

c. What is the major concern when dealing with fluid containing boric acid? What is done to alleviate this concern? (0.5)

d. List ALL combinations that will cause the selected boric acid transfer pump to start. Include switch positions and input signals. (1.0)

QUESTION 2.08 (2.50)

COMPLETE and LABEL the attached diagram of a basic RCP. INDICATE all cooling flowpaths, major valves in the flowpaths, sources of cooling water, and all instrumentation associated with the cooling flowpaths. (2.5)

QUESTION 2.09 (3.00)

a. What THREE purposes does the bypass designed into the number 2 high pressure turbine stop valve perform? (1.0)

b. State TWO reasons for using Moisture Seperator Reheaters after the High Pressure Turbine? (1.0)

. What is the purpose of the two atmospheric relief diaphrams on the top of the low pressure turbine. (1.0)

QUESTION 2.10 (3.00)

ESF systems are designed in accordance with the single failure criteria. This means that a fluid or electrical system is considered to be designed against a single failure if the failure is of any ACTIVE component (assuming all passive components work properly) or a single failure of any PASSIVE component (assuming all active components work properly).

Define ACTIVE and PASSIVE failure as it applies to the statement above. (3.0)

(***** END OF CATEGORY 02 *****)

QUESTION 3.01 (2.50)

~~a.~~ The plant is at 100% power with the rod control system in automatic. Explain the response of the rod control system if the turbine impulse chamber pressure signal feeding rod control fails low. Carry your explantion to the point of no rod motion and assume no operator ~~action or~~ ~~[illegible]~~ ~~[illegible]~~ action. (2.5)

QUESTION 3.02 (2.00)

a. List the source and signal inputs that program and actuate the Cold Overpressure Protection System (COPS). Be specific for EACH TRAIN. (1.0)

b. What actions occur when Train A and Train B ARM/BLOCK switches are placed in the ARM position? (1.0)

QUESTION 3.03 (3.00)

a. List the signal(s) that are used by the Master Pressurizer Level Controller. (.75)

b. What band is pressurizer level programmed to follow? (.75)

c. Define pressurizer level error. What is pressurizer level error used for? (1.5)

QUESTION 3.04 (2.00)

a. Explain the purpose of the steam pressure input used in the developement of a steam flow signal for the S/G water level control system. (1.0)

b. Explain how INDICATED steam flow would compare to ACTUAL steam flow if, during a power increase from 0-100%, the steam pressure signal stuck at it's 50% value. (1.0)

QUESTION 3.05 (2.00)

~~State the 5 interlocks that must be satisfied to open an RCS cold leg loop isolation valve.~~ (2.0)

(delete & replaced)

QUESTION 3.06 (2.00)

a. Define "Degree of Coincidence" as it applies to the solid state protection system (SSPS). (0.5)

b. Explain why some protection curcuits are built with 3 detectors, 3 channels and a 2/3 coincidence while others use 4 detectors, 4 channels and a 2/4 coincidence. (1.5)

QUESTION 3.07 (3.00)

The plant is at 100% power and stable. A maintenance person inadvertantly trips the turbine but the reactor does not trip. After 30 seconds the BOP operator de-energizes the Rod Drive M.G. sets. Describe the response of the steam dump system to this situation assuming no further operator action. Continue your discussion to the point where RCS temperature is stable the steam dumps close. Be specific. (3.0)

QUESTION 3.08 (3.00)

List ALL reactor trips that are affected either manually or automatically by a PERMISSIVE. Include the name of the trip and the associated permissive(s). (3.0)

QUESTION 3.09 (3.50)

a. List all of the uses for INDIVIDUAL detector signals from the power range instrument. (Signals tapped off prior to the summing amplifier.) (1.5)

b. Explain the operation of the detector current comparator and the channel current comparator. Also state what each checks for, when they are in service, and when they alarm. (2.0)

(***** CATEGORY 03 CONTINUED ON NEXT PAGE *****)

QUESTION 3.10 (2.00)

Refer to the attached drawing, EN-2. On a your answer page, fill in the name of each region next to it's respective number. Explain why there are two seperate lines labeled 1 and 2 on the graph. (2.0)

(***** END OF CATEGORY 03 *****)

QUESTION 4.01 (2.00)

Monitoring the board after assuming the watch as reactor operator, you see that all of the safety injection accumulators are out of the required Tech. Spec. band and indicate as follows:

pressure: 585 psig
level: 60% (810 cu ft or 6060 gals)

a. For each parameter above, STATE if the value is ABOVE, BELOW, or EQUAL TO the required Tech Spec value. (1.0)

b. If the accumulators were left as found and a LOCA were to occur, would reactor safety be affected? EXPLAIN. (1.0)

QUESTION 4.02 (3.00)

The reactor is at 8% power with the turbine on the grid at 50 MW. The unit is in Cycle One with boron concentration at 900 ppm. Rods are in manual with bank D at 160 steps. CALCULATE the dilution and dilution rate that will be required to escalate power to 80% at 1%/min and have bank D rods at their rod stop limit. STATE all assumptions, show ALL work and show ALL values used with their proper units. (3.0)

QUESTION 4.03 (4.00)

According to the Reactor Startup Procedure, OP 3202:

a. What action(s) are required to be taken by the reactor operator if core boron concentration is changed by more than 50 ppm? EXPLAIN. (1.5)

b. How often must bank demand position be compared to digital position indication while starting up the reactor? WHY? (1.0)

c. If criticality is not achieved by the time rods reach their maximum calculated position, what action is required? (Do not include any notifications) (1.5)

(***** CATEGORY 04 CONTINUED ON NEXT PAGE *****)

QUESTION 4.04 (2.00)

When using the procedure for cooldown, Cooldown Outside Control Room, EOP 3504, a caution warns the operator of the possibility of voiding in the RCS. List TWO ways that voiding can be overcome should it occur. Include All means that may be used to accomplish each. (2.0)

QUESTION 4.05 (3.00)

a. State FIVE conditions that require immediate boration. (1.0)

b. How long is immediate boration to be continued once started? (0.5)

c. If the immediate boration flow is EXACTLY the minimum required by AOP 3566, Immediate Boration, how long must immediate boration flow be continued to insert 100 ppm into the RCS? Assume charging flow to be equal to or greater than boration flow. STATE all assumptions made and SHOW all work. (1.5)

QUESTION 4.06 (2.50)

After working in an area for 2 hours, a worker discovers his pocket dosimeter is off scale and leaves the area. A subsequent survey reveals a hot area of 1200 mr/hr at 2 ft. from the "hot spot". The worker's activities were primarily at 5 ft. from the "hot spot".

a. Determine the exposure the worker received. (1.25)

b. If the worker's previous exposure was 900 mr. What LEGAL (10CFR20) exposure limits, if any, were exceeded? State ALL assumptions. (1.25)

QUESTION 4.07 (3.50)

During the use of EOP 35 E-1, "Loss of Reactor or Secondary Coolant", a steam generator found to be faulted is to be verified isolated by doing what 7 actions? (3.5)

QUESTION 4.08 (3.50)

According to ES-1.1, SI Termination, what are the five indications that are used to determine natural circulation flow. Include, where applicable, the desired status (stable, increasing, decreasing, saturation). Actual setpoints or values are not necessary. (3.5)

QUESTION 4.09 (1.50)

According to EOP-35 ECA-0.0, "Loss of All AC Power":

a. When can the Functional Response Procedures be implemented?

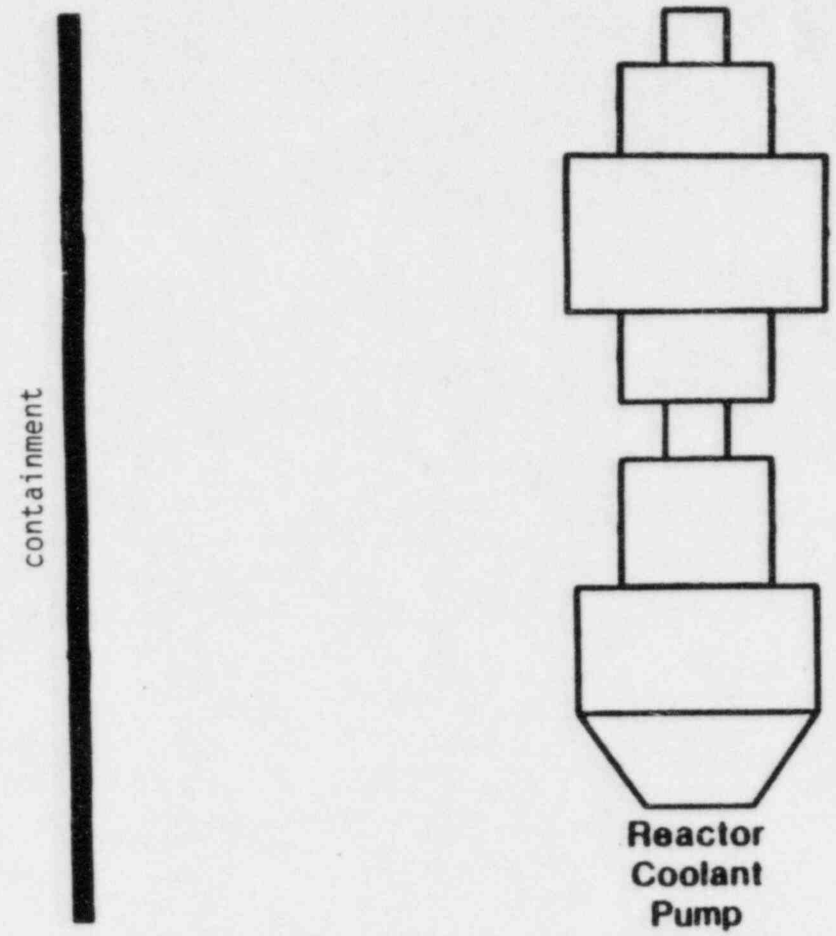
b. What action is required if SI is active or actuates while in EOP 35, ECA-0.0?

c. If a faulted steam generator is discovered, why must the steam generator pressure be reduced to less than 160 psig? (1.5)

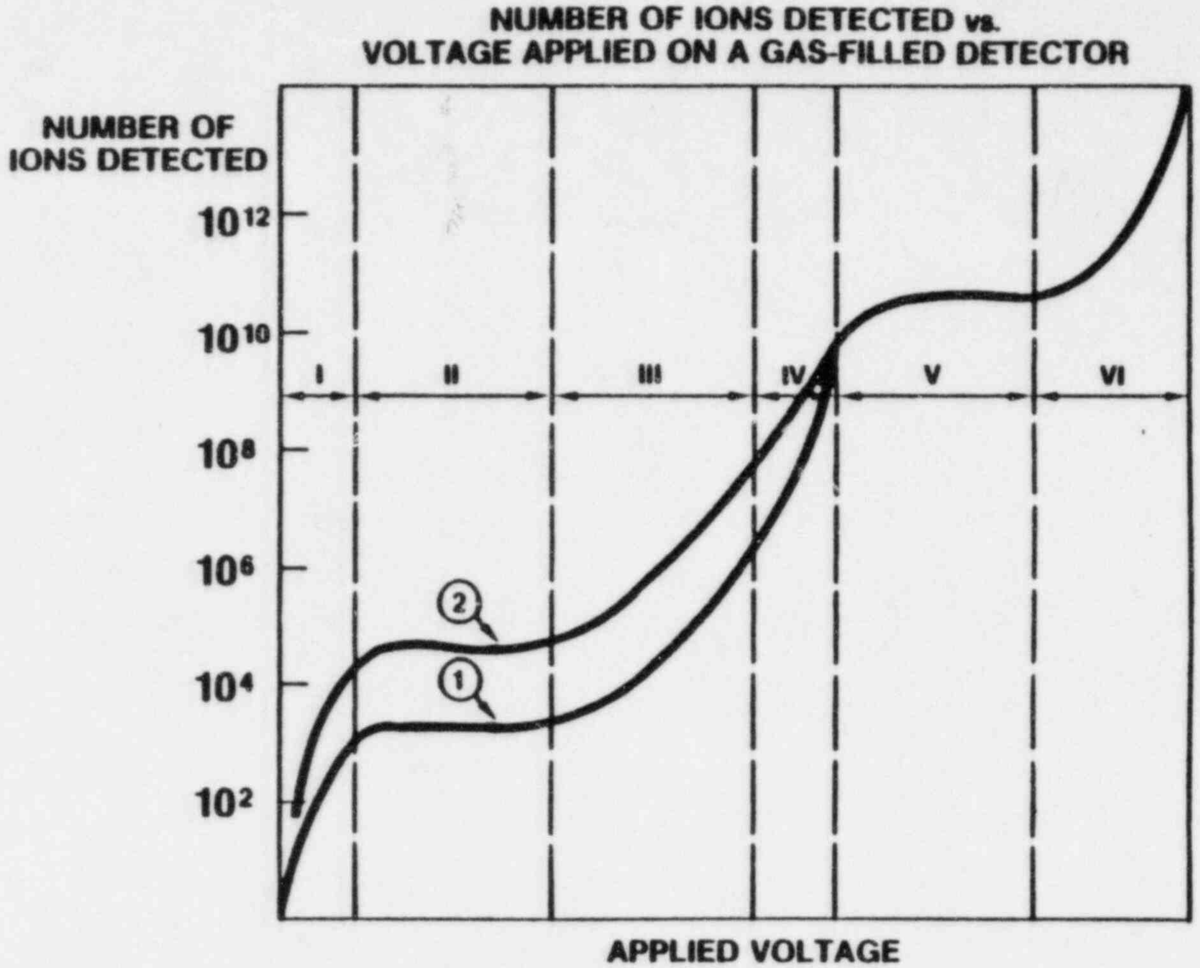
deleted

(***** END OF CATEGORY 04 *****)
(************* END OF EXAMINATION ***************)

COOLING WATER TO THE REACTOR COOLANT PUMP



GAS-FILLED DETECTOR CURVE



122511.2
F2 4605

NOMOGRAPH CORRECTION FACTORS

Plant Conditions			Correction Factor (K) (See Note)
Pressure (psig)	T (Avg) (°F)	Pressurizer Level	
2235	557-584	Normal Operating	1.00
1600	500	No-Load	1.05
1200	450	No-Load	1.10
800	400	No-Load	1.16
400	350	No-Load	1.18
400	300	No-Load	1.20
400	300	Solid Water	1.35
400	200	No-Load	1.28
400	200	Solid Water	1.40
400	100	Solid Water	1.47

Note: Correction factors are applied as follows

(a) Boron addition and dilution total volume nomographs

$V_{(Corrected)} = K \times V_{(Nomograph)}$

(b) Boron addition and dilution rate nomographs

$\frac{dc}{dt}(Corrected) = \frac{1}{K} \times \frac{dc}{dt}(Nomograph)$

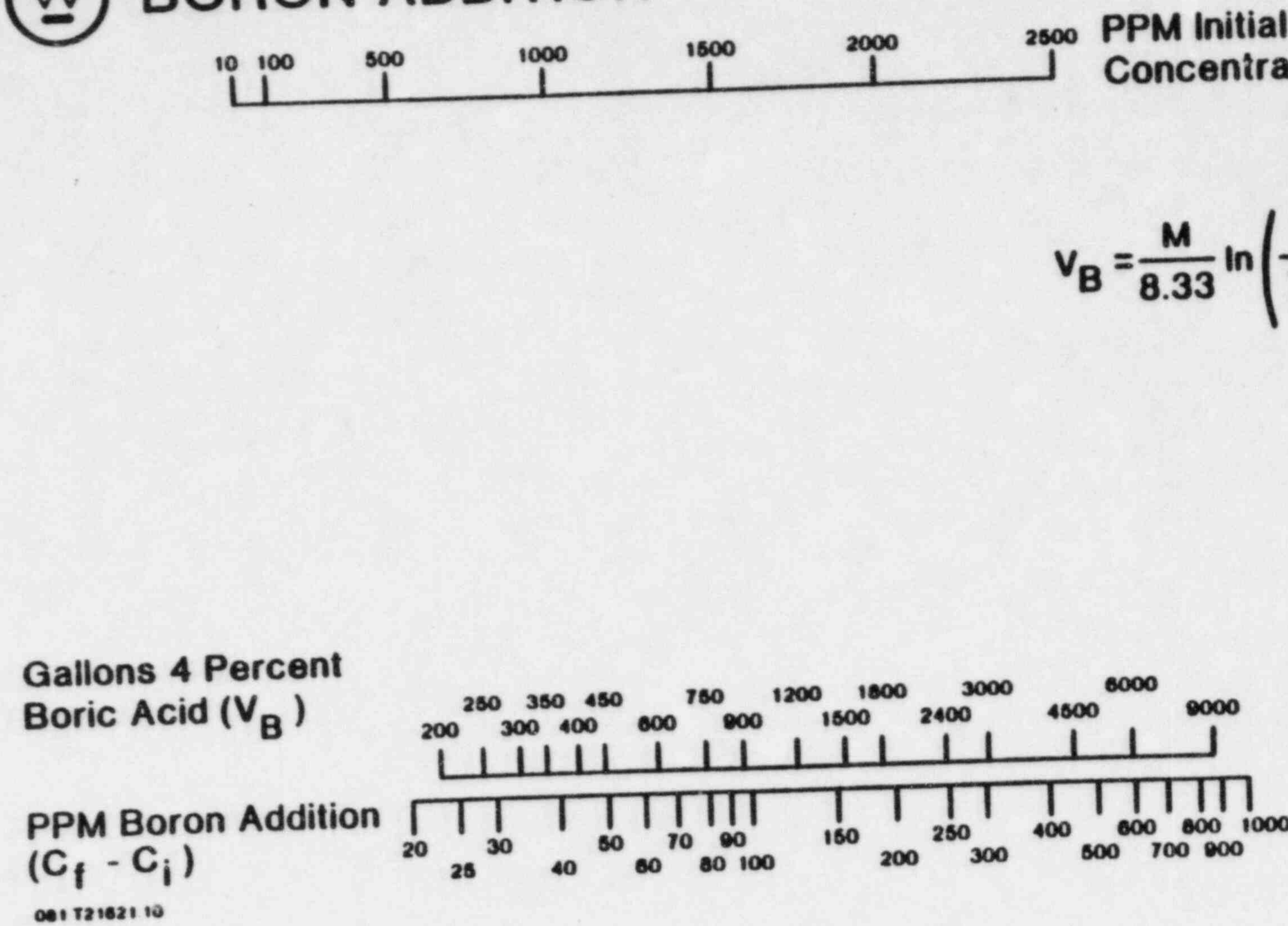
081TW1621.8

BLENDED FLOW BASED ON 120 GPM AUTO MAKEUP

Coolant Boron Concentration (PPM)	0	100	200	300	400	500	600	700	800	900	1000
4 Percent Boric Acid Flow (GPM)	0.0	1.71	3.4	5.1	6.9	8.6	10.3	12.0	13.7	15.4	17.1

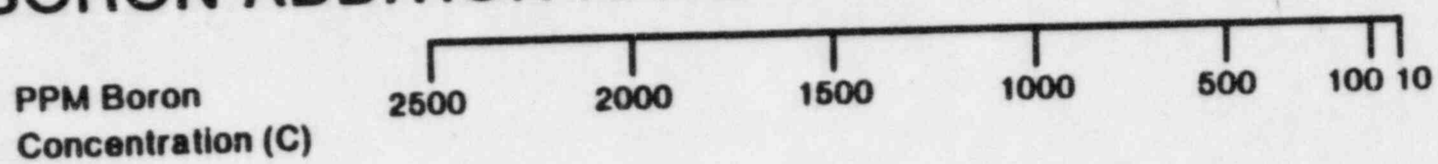
Coolant Boron Concentration (PPM)	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
4 Percent Boric Acid Flow (GPM)	17.1	18.9	20.6	22.3	24.0	25.7	27.4	29.1	30.9	32.6	34.3

BORON ADDITION

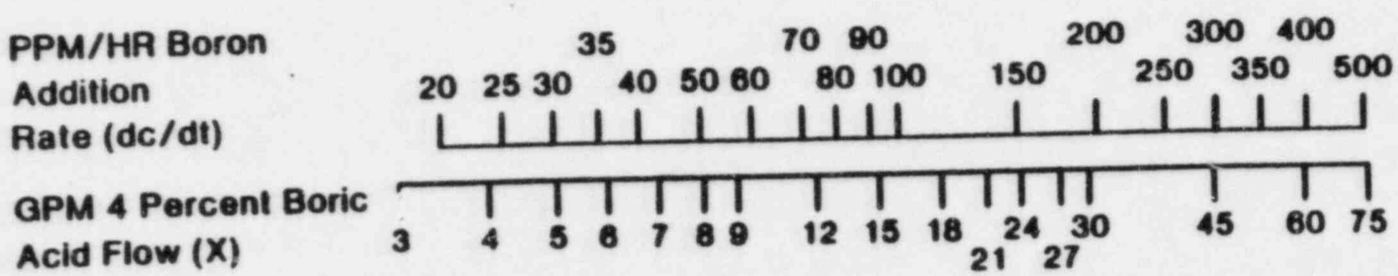


$$V_B = \frac{M}{8.33} \ln\left(\frac{7000-C_i}{7000-C_f}\right)$$

BORON ADDITION RATE

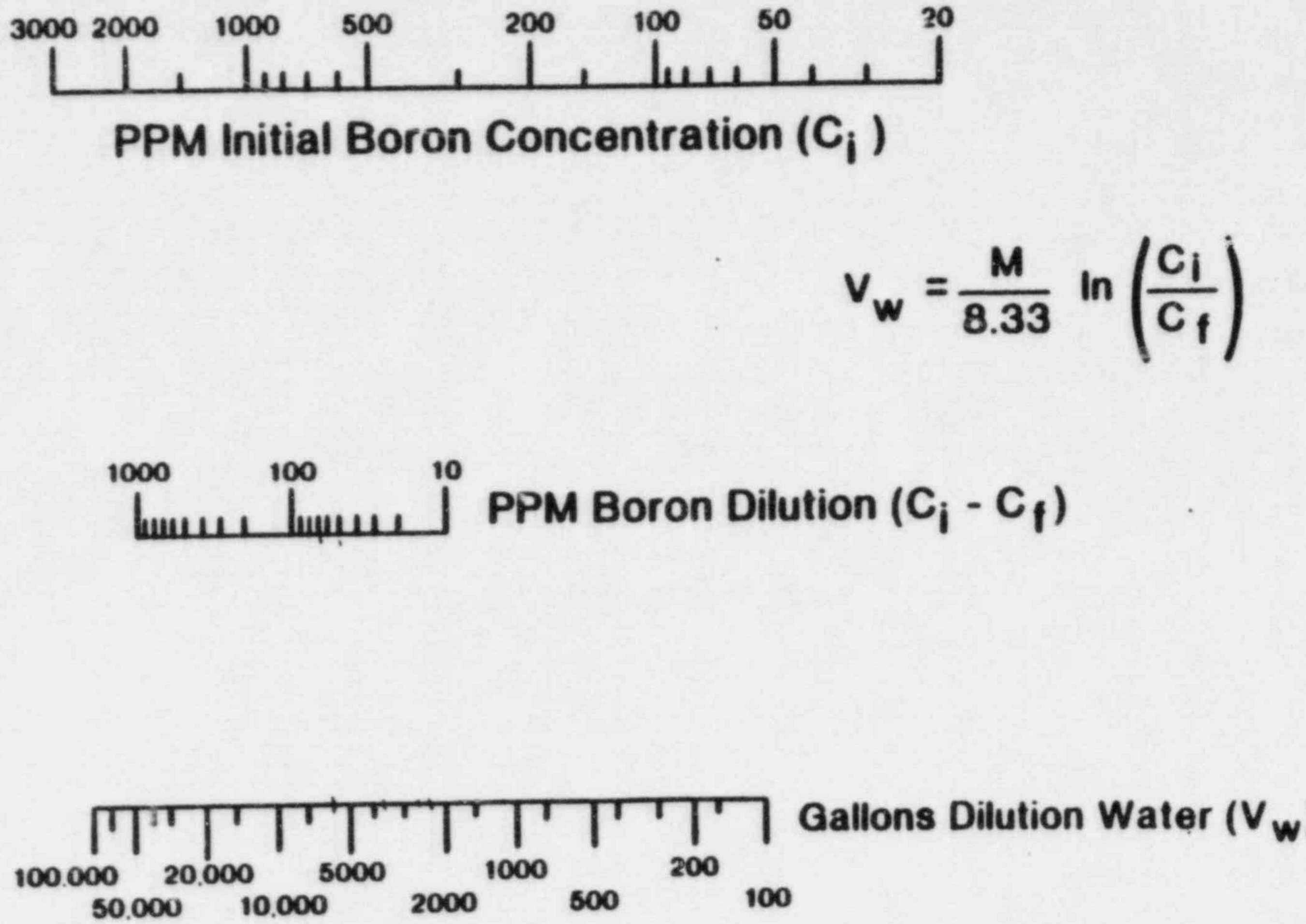


$$\frac{dc}{dt} = \frac{500X}{M}(7000\text{-}C)$$



081 T21621 11

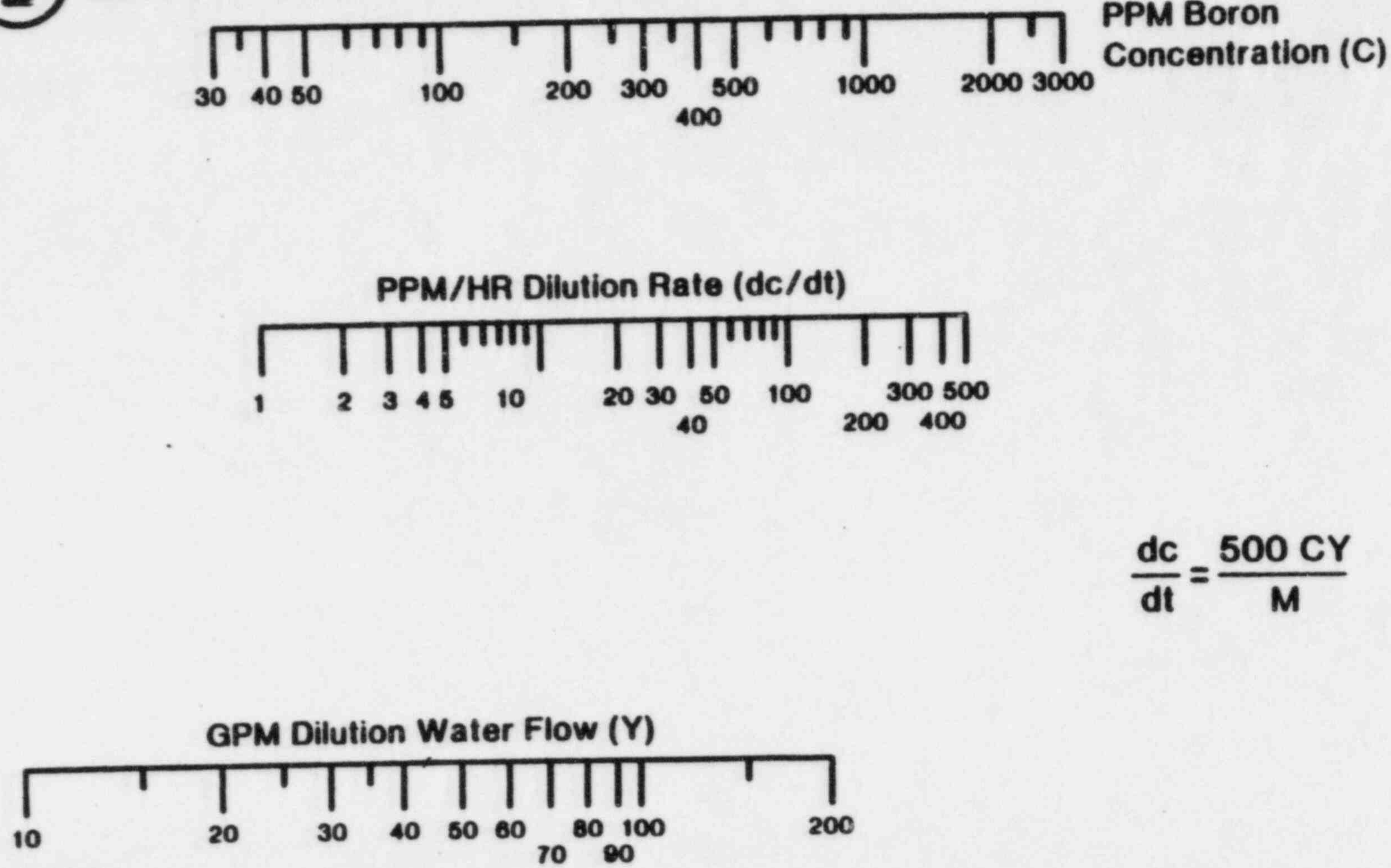
BORON DILUTION



$$V_w = \frac{M}{8.33} \ln\left(\frac{C_i}{C_f}\right)$$

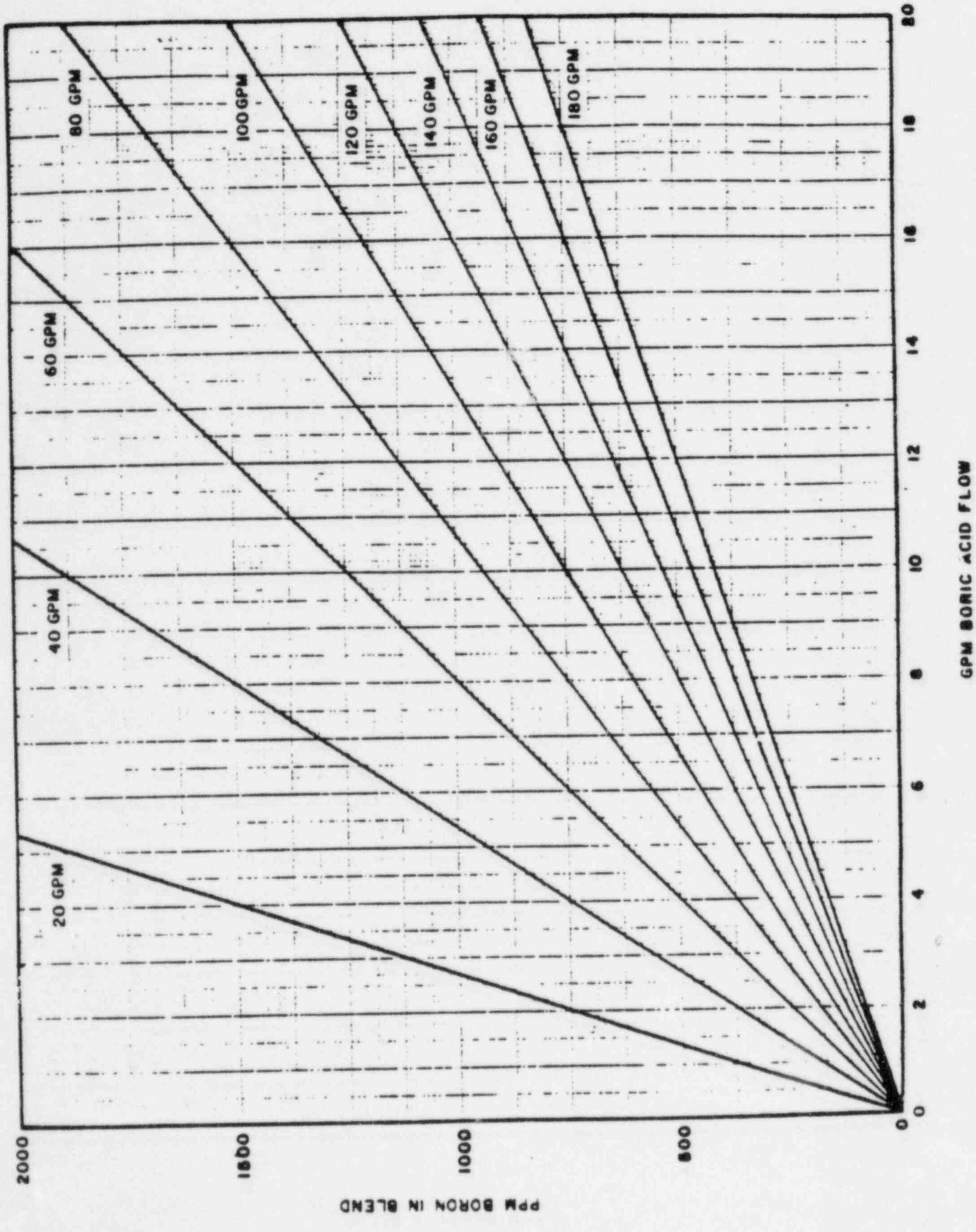
081 T21621 12

BORON DILUTION RATE



$$\frac{dc}{dt} = \frac{500\,CY}{M}$$

081 T21621 13



BLENDED FLOW AS FUNCTION OF BORIC ACID
AND TOTAL FLOW RATES

ANSWERS -- MILLSTONE 3 -85/05/14-HEMMING, W.

MASTER COPY

ANSWER 1.01 (2.00)

NO, the dilution (and subsequent startup) should NOT be continued. [.5] Source range counts have doubled on one channel[0.5], this would infer that 1/2 of the amount of reactivity to go critical has been added.[.5] To dilute by an additional 100 ppm would probably take the reactor critical. [.5] (slightly supercritical) 2.0 ~~(1.5)~~

REFERENCE
Millstone Reactor Theory,Pp 10.2-10.6.
Reactor Theory Text, Pp. RT-8.8 and 9, Equations 8-9 and 8-10.

ANSWER 1.02 (3.00)

a. No[0.5]. Because the value of neutron flux appears in both the numerator and the denominator of the expression for Xenon, the equilibrium value will not change directly proportional with power level[0.5]. Physically, this is because flux increases burnout as well as production. Therefore, doubling the power increases the equilibrium Xenon concentration because the denominator of the fraction becomes smaller, but the value does not double.[0.5] (1.5)

b. 50% is reached faster[0.5]. Equilibrium Xenon is dependent on flux level and in this case reaches it's equilibrium value sooner at the higher power level.[1.0] (1.5)

REFERENCE
Millstone Reactor Theory, RT-16, Pp 16.3-16.4, and figure 16-4.

ANSWER 1.03 (3.00)

a. Rod worth will increase with neutron flux,[.5] therefore, rod worth increases from the outside edge of the core to the middle of the core [.5] accept correct description of inside to outside placement also (1.0)

b. As boron concentration increases, rod worth decreases [.5] because of the higher competition for neutrons. [.5] (1.0)

c. As the moderator temperature increases, rod worth increases [.5] because the thermal diffusion length increases, thus more neutrons are in the epithermal range and available for rods to absorb. [.5] (1.0)

REFERENCE
Millstone Reactor Theory, RT-14, Pp 2-5.

ANSWER 1.04 (3.00)

a. The excess steam flow causes Tave to decrease and insert positive reactivity [0.5]. Power increases. At the POAH, negative reactivity from FTC [0.5] and Tave decrease slows [0.2]. Power rise and cooldown continues until reactor power equals steam demand [0.3]. (Until MTC and FTC balance) (1.5)

b. Power rise rate higher and time to reach POAH shorter [0.5] due to smaller beta-bar and more negative MTC [0.5]. Final power is the same but temperature will be higher (still below no-load Tave) [0.5] (1.5)

REFERENCE
Millstone Reactor Theory, RT-18, page 18.5

ANSWER 1.05 (1.00)

Total power coefficient is more negative at EOL than BOL primarily due to the large increase in the magnitude of MTC, due to boron dilution. (1.0)

ANSWERS -- MILLSTONE 3 -85/05/14-HEMMING, W.

REFERENCE
Millstone Reactor Theory, RT-13, Pp 13.5

ANSWER 1.06 (1.50)

a. The gases contaminate the gap which reduces the thermal conductivity of the helium gas which raises the temperature of the fuel. (1.0)

b. LESS negative. (0.5)

REFERENCE
G.P. Heat Transfer and Fluid Flow, Pp 235-240.
Millstone Reactor Theory, RT-13, p2.

ANSWER 1.07 (3.00)

a. Moderator Temperature Coefficient (MTC) [0.5] due to an increase (more negative) in MTC as boron concentration is reduced over core life [0.5]. (1.0)

b. Power defect has a stabilizing influence on reactor operation because it resists power changes. (As power increases, power defect adds negative reactivity and as power decreases, power defect adds positive reactivity). (1.0)

c. Doppler (FTC) [0.5]. Fuel temperature changes first [0.5]. (1.0)

REFERENCE
Millstone Reactor Theory, RT-13, Pp 6-7 and RT-12.

ANSWER 1.08 (2.50)

a. As condensate depression increases it lowers plant efficiency because of the heat removed has to be replaced by the reactor with no usable work out or visa-versa. (1.5)

b. By ~~decreasing~~ increasing condensate depression the NPSH is ~~decreased~~ increased on the condensate pumps (and visa-versa.) (1.0)

REFERENCE
G.P. Heat Transfer and Fluid Flow, P 182.

ANSWER 1.09 (2.50)

a. Subcooling is based on core exit T/C or hot leg RTD readings. During natural circulation the mass of metal in the head can retain heat and keep local temperatures above saturation. The temperature indicators would not reflect this local saturated condition. (1.5)

b. Pressurizer level decreases because the pressurizer pressure increase will compress the vessel void and force water out of the pressurizer. (1.0)

REFERENCE
G.P. Heat Transfer and Fluid Flow, Pp 355-358.

ANSWER 1.10 (2.50)

a. Decrease

b. Decrease

c. ~~Decrease~~ Increase

d. Decrease

e. No Change

(2.5)

REFERENCE
G.P. Heat Transfer and Fluid Flow, section B.1

ANSWER 1.11 (1.00)

Incorrect. As the delta T increases out of the natural convection region and enters into the nucleate boiling region, the heat flux changes in a nonlinear fashion up to the point of DNB. (1.0)

REFERENCE
General Physics Heat Transfer, Thermodynamics, and Fluid Flow Fundamentals, p 125.

ANSWER 2.01 (2.50)

a. No, as the plant pressure changes so will the delta-p across the #1 seal thus changing the seal flowrate. (1.0)

b. The #3 seal standpipe and the VCT pressure. (.75)

c. Through #2 seal (to the CDTT) and the seal return line relief valve (to the PRT). (.75)

REFERENCE
Millstone System Descriptions, topic 1, lesson 2, Pp 15 and figure RP 14

ANSWER 2.02 (2.00)

a. Maintains water to the steam generators when the main feedwater system is not operating for routine non-emergency conditions and is part of the Engineered Safeguards Systems where it functions to prevent core damage by maintaining water to the heat sink during emergency conditions (such as a small break LOCA). (.75)

b. The Auxiliary Feedwater System must deliver at least 470 gpm to two (2) steam generators within 60 seconds to prevent a solid condition from developing. (1.25)

REFERENCE
Millstone System Descriptions, topic 4, lesson 2, P 3.

ANSWER 2.03 (2.00)

Jacket water cooling system; prewarming the system to insure engine up to temperature, reduce stress.

Lube oil system; prewarming and/or prelubrication insures the engine will be able to assume load immediately.

Air start system; precharged to insure starting air is available immediately.

Fuel system; auxilary pump installed to insure immediate pressure to injectors.

(ANY THREE) (2.0)

REFERENCE
Millstone System Descriptions, diesel generator and support systems, Pp 5-7, 25-26, 32-33.

ANSWER 2.04 (3.00) (See supplied answer and references)

a. Stops EGLS LOP output signals
Allows manual control of loads once SI is reset
EGLS becomes inoperative of any new initiating signals. (1.5)

b. For three seconds after the EGLS LOP reset is depressed the EGLS will respond to a new LOP signal. After three seconds it becomes inoperative. (.75)

c. Depressing the Station LOP RESET after the EGLS LOP RESET is depressed will reset the EGLS to a fully armed and ready condition. (.75)

REFERENCE
Millstone System Descriptions, D/G Sequencer, Pp5

ANSWER 2.05 (2.00)

a. -Pzr. level < 17%
-loss of power or air (1.0)
closure of valves 459 or 460

b. 1. controls pressure downstream of the letdown orifices to eliminate flashing and two phase flow.

2. controls flowrate out of the RCS via RHR to control system pressure. (1.0)

REFERENCE
Millstone System Descriptions, topic 2, lesson 1, Pp 9, 11-12
P&ID EM-104A-18

ANSWER 2.06 (2.00)

a. (1) Reduces thermal stress to the spray line and spray nozzle.
(2) Reduces thermal stress to the surge line
(3) Maintains pressurizer chemistry uniform with RCS
(4) Promotes mixing in the pressurizer [any 3, .33 ea] (1.0)

b. Spray line or surge line low temp alarms (0.5)

c. Loop 1 and loop 2 (0.5)

REFERENCE
Millstone System Descriptions, topic 1, lesson 4, Pp 6-8 and figure PR-2

ANSWER 2.07 (3.00)

a. Dilute mode travels only to the top of the VCT (spray nozzle). Alternate Dilute travels to the top and bottom of the VCT. (spray nozzle and suction of the charging pumps) (.75)

b. The Alternate Dilute path offers a fast method of dilution but used over a period of time will deplete the hydrogen in the RCS. A second path for routine dilution that does not affect hydrogen was designed into the system. (.75)

c. Boric acid leaving solution (crystallization). [.25] The temperature of any system containing boric acid is kept elevated to a temperature which is based on the concentration of the boric acid. [.25] (Or maintaining BA concentration low enough to alleviate crystallization ~~for various systems~~ at room temperature) (0.5)

d. 1. Reactor Makeup Mode Selector in BORATE or MANUAL and the Reactor Makeup Control Switch in START.
   2. Reactor Makeup Mode Selector in AUTO, the Reactor Makeup Control Switch in START, and VCT level at the low level makeup setpoint. (1.0)
   3. Pushbuttons on MCB to START

REFERENCE
Millstone System Descriptions, topic 2, lesson 2, Pp 14, 19, 29-31.

ANSWER 2.08 (2.50)

Figure RP-21 in Millstone S.D. topic 1, lesson 2. Copy attached

Drawing requirements:
- 4 labeled supply and return headers
- 4 labeled components cooled in RCP
- 4 cooling flowpaths
- ~~4 flow indicators (with orfices)~~ — Delete per C.E.
- 3 relief valves
- 4 containment isolation valves (one is a check valve
- Thermal barrier isolation valve (air)
- Thermal barrier supply side check valve

[.119ea] (2.5)

No points off for CVCS cooling included

REFERENCE
Millstone Systen Description, topic 1, lesson 2, drawing RP-21.

ANSWER 2.09 (3.00)

a. Slow (Chest) warming of the stop valves.
Pressurizing the stop valves for opening.
Pressurizing below the seat areas up to the CIV's for shell warming. (1.0)

b. Increase thermal efficiency of the turbine.
Minimize erosion damage to the low pressure turbine. (1.0)

c. They protect the exhaust hood and the condenser against excessive steam pressure if circulating water is lost. (1.0)

REFERENCE
Millstone System Descriptions, topic BOP2-3, Pp 5-11

ANSWER 2.10 (3.00)

An Active Failure is the failure of a powered component such as a piece of mechanical equipment, component of an electrical supply system, or instrumentation and control equipment.

A Passive Failure is the structural failure of a static component which limits it's effectiveness in carrying out it's designed function. (3.0)

REFERENCE
Millstone System Descriptions, topic 3, lesson 1, p 19.

ANSWER 3.01 (2.50)

The low impulse pressure signal would cause rods to drive in at maximum speed. [.75] In a short period of time, the power mismatch input to the rod control system will fade. [0.5] ~~and the mismatch developed between Tref, now at the no-load value, and Tavg, which should be below the no-load value for Tavg, will take over auto rod positioning. [0.5] Rods will now step as necessary to restore Tavg to no-load Tref at a speed determined by the temperature inputs. [.75]~~ Temperature mismatch between Tavg and Tref will attempt to move rods out to restore Tave to Tref, however C-5 will not be available and auto rod control in the outward direction inhibited. (.75) (.5) (2.5)

REFERENCE
Millstone System Descriptions, topic 6, lesson 2, Pp 19-21 ← see attached sheet for an additional answer

ANSWER 3.02 (2.00)

a. Train A- auctioneered low wide range Thot
wide range RCS pressure (PT405)
Train B- auctioneered low wide range Tcold
wide range RCS pressure (PT403) [.25 ea] (1.0)

b. The respective PORV block valve will open if it's control switch is in automatic and the PORV's lift setpoint source becomes the COPS programmer. (1.0)

REFERENCE
Millstone System Descriptions, topic 6, lesson 6&7, Pp 15-16

Millstone 3 RxO Exam (May '85)
wrt question 3.01

two different answers are acceptable, based on different sources of information:

- Based on training material
  Topic 8 - Integrated Plant
  Lesson 4 - I&C Failure Analysis
  Pages 45-46
  ... due to mismatch between rx power and stm demand, as Tavg drops the coolant will contract. Pzr level will drop rapidly causing plant pressure to drop, the rx will probably trip.

- Based on simulator experiences, the reactor does not trip.

ANSWER 3.03 (3.00)

a. Charging flowrate
Actual pzr level
Program level [.25 ea] (.75)

b. ~~Auctioneered high Tavg.~~
25% at 557 F. to 61.5% at 587 F. (.75)

c. Level error is the difference between actual pzr. level and programmed level. [.75]

Energizes backup heaters on a +/- 5% level deviation.
Energizes pzr. level deviation alm.
Provides input to control charging flowrate.
[.25 ea] (1.5)

REFERENCE
Millstone System Descriptions, topic 6, lesson 6&7, Pp 25-26

ANSWER 3.04 (2.00)

a. Steam pressure is used to compensate the steam flow signal for density variations in the steam as power increases. (1.0)

b. Indicated steam flow will be ~~lower~~ higher than actual. (1.0)

REFERENCE
Millstone System Descriptions, topic 6, lesson 9, p 18.

ANSWER 3.05 (2.00)

Deleted and replaced, see next page

1. Isolated hot leg wide range temperature must be within 5 DegF of auctioneered high wide range Thot.

2. Isolated cold leg wide range temperature must be within 5 DegF of auctioneered high wide range Tcold.

3. Hot leg isolation valve must be open.

4. Bypass isolation valve must be open.

5. Sufficient flow through the bypass/mixing line (200 gpm) (2.0)

(3.05 and 6.02)

(Q) a. State TWO interlocks associated with the RHR suction valves (8701 A/B or 8702 A/B). (Includ any applicable setpoints) (1.5)

b. The RCS is in a cold solid condition with cleanup via CVCS demineralizers in progress. Which component is utilized to control RCS pressure? (0.5)

c. State TWO conditions that would AUTOMATICALLY trip an RHR pump (SRO only)

(A)

a. - Will not open unless RCS (loop WR) pressure is less than 425 psig
- Will automatically close at 700psig RCS (loop WR) pressure.
- Will not open unless valves 8804, 8812, 8837 and 8838 are closed. [2 required @ 0.75 each] (1.5)

b. Letdown Pressure Control Valve (PCV-131) (0.5)

c. (SRO Only)
- RWST level (< 36 feet) low with SI signal present (CAF)
- Loss of power signal
- Motor protection signal L.O. Relay
- Buss differential L.O. Relay (Busses 34C or D)
[any 2 @ 0.5 each] (1.0)

Millstone 3 Volume I, Topic 1, Lesson 6, pages 7-10

REFERENCE
Millstone System Descriptions, topic 1, lesson 1, Pp 15-16.

ANSWER 3.06 (2.00)

a. Degree of coincidence is the number of input channels required to intiate a protective action as compared to the total number of input channels. (0.5)

b. Three detectors may be used and a 2/3 logic developed if NO control action occurs from a protection channel or a backup form of protection exsists.

For a safety grade system or if a channel is used for both protection and control purposes, 4 detectors and a 2/4 coincidence is required. (1.5)

REFERENCE
Millstone Systems Descriptions, topic 7, lesson 1,2, and 3, Pp 8-11, 73 and topic 8, lesson 4, p 6.

ANSWER 3.07 (3.00)

Due to the lack of a P-4 signal, the steam dumps will arm using the Loss of Load controller.[.75] Because of the instant drop in impulse chamber pressure, the loss of load controller will see an instantaneous 28 DegF deviation. This deviation will cause both the Hi-1 and Hi-2 bistables to trip which will trip open all three banks of steam dumps.[.75] The banks will remain open until temperature drops allowing the Hi-2 bistable to reset thus allowing bank 3 to cycle shut and then bank 2. When the Hi-1 bistable resets, bank 1 will cycle shut.[.75] When all banks of steam dumps are closed, RCS temperature will be 2 DegF above no-load Tavg due to the 2 DegF deadband in the loss of load controller.[.75] (3.0)

REFERENCE
Millstone System Descriptions, topic 5, lesson 2, p 12 and figure SD 4 & 5.

ANSWER 3.08 (3.00)

TRIPS	PERMISSIVES
1. S.R. HI flux	1. P-6, P-10
2. I.R. Hi flux	2. P-10
3. P.R. Hi flux lo stpt	3. P-10
4. Pzr. low pressure	4. P-7, P-10, P-13
5. Pzr. hi level	5. P-7, P-10, P-13
6. Single loop LOF	6. P-8
7. Two loop LOF	7. P-7, P-10, P-13
~~8. RCP low shaft speed~~ deleted	8. ~~P-17~~
9. RCP lo-lo shaft speed	9. P-7, P-10, P-13
10. Turbine/Reactor	10. P-9

[.1 ea] (3.0)

REFERENCE
Millstone System Descriptions, topic 7, lesson 1,2 and 3, Pp 65-70 and Table 4.

ANSWER 3.09 (3.50)

a. 1. OPdT and OTdt trip setpoint calculation curcuits.
2. NR-45 recorder
3. NR 41-44 recorders — {Accepted current indication on drawer for ½ credit.}
4. Detector current comparator circuit
5. Plant computer
6. Delta flux meters, accepted input to ΔI computer (1.5)

b. The detector current comparator compares each upper (lower) detector to the average of all the upper (lower) detectors. [.25] It alarms when any detector output exceeds the average by 1.02 [.25] It monitors upper (lower) quadrant power tilts. [.25] and is active only when power exceeds 50%. [.25]

The channel current comparator compares the output of all ~~fours~~ four power range summing amplifiers to each other. [.25] It alarms when any two channels deviate from one another by 2%. [.25] Monitors for quadrant power distribution [.25] and is always active. [.25] (2.0)

REFERENCE
Millstone System Descriptions, topic 6, lesson 4, Pp 20-21,26,28.

ANSWER 3.10 (2.00)

a. I. recombination
II. ionization
III. proportional
IV. limited proportional
V. geiger mueller
VI. continuous discharge [.25 ea]

#1 curve is detector characteristics for gammas
#2 curve is detector characteristics for alphas [.25 ea] (2.0)

REFERENCE
Millstone System Descriptions, topic 6, lesson 4, Pp 6-7 and figure EN-2.

ANSWER 4.01 (2.00)

a. ~~Both parameters are BELOW the required Tech Spec value. (T.S. values are approx. 850 cu.ft. and 650 psig.)~~ ~~(1.0)~~

b. Reactor safety would be jeapordized because the accumulators lack sufficient pressure and inventory for proper injection. (answer will be graded accordingly if candidate responds that the indicated parameters are above T. S. limits) (2.0)

Graded B based on answer given in A, no credit gained or lost on first part.

REFERENCE
Millstone Systems Descriptions, topic 3, lesson 3, Pp 55-56

ANSWER 4.02 (3.00)

Bank D reactivity...170 pcm (+/- 5) accepted 100-300 pcm [.1]
Power Defect 8%-80%:1500pcm(+/- 10) - 160pcm(+/- 10)= 1340pcm (+/- 20) accepted 936-1296 pcm [.9]
Total reactivity....1340pcm(+/- 20) - 170pcm(+/- 5)= 1170pcm (+/- 25) [.4]
Diff. Boron Worth...10.75 pcm/ppm (+/- .1) accepted 9-11 pcm/ppm [.4]

Dilution = 1170 pcm / 10.75 pcm/ppm = 109 ppm (+/- 5) [.3]

Gallons from nomograph...8000 gallons (+/- 250) [.3]
Dilution Time............109 ppm over 1.2 hours = 91 ppm/hr (+/- 5) [.3]
Dilution Rate nomograph..112 gpm (+/- 5) [.3]

(3.0)

REFERENCE
Millstone curve book.

ANSWER 4.03 (4.00)

a. Pzr. heaters must be energized to induce spray flow. This insures proper mixing in the pzr. which equalizes the boron concentration between pzr. and RCS. (1.5)

b. Every 50 steps. This insures proper group alignment. (1.0)

c. Insert all control banks, measure RCS boron concentration, and recalculate the ECP. (1.5)

ANSWERS -- MILLSTONE 3 -85/05/14-HEMMING, W.

REFERENCE
Millstone Reactor Startup Procedure, OP 3202, Pp 8-10.

ANSWER 4.04 (2.00)

1. Increase RCS pressure by using pzr. heaters or increase charging if plant is solid.

2. Decrease RCS temperature by feeding and steaming S/G's, operation of core cooling equipment, or adjusting RHR flow.

3. (increasing RCS flow is listed in the procedure as a third choice, however no methods for achieving it are listed. Full credit will be be given, if this answer is chosen by the candidate, based on the information supplied by the facility.) (2.0)

[any two] Cooling head and starting RCP's accepted with partial credit.

REFERENCE
Millstone Procedures, EOP 3504, p 3

ANSWER 4.05 (3.00)

a. 1. Control bank below the lo-lo insertion limit.
   2. Failure of one or more RCCA's to fully insert on a trip.
   3. Uncontrolled cooldown of the RCS on a trip or shutdown.
   4. Uncontrolled or unexplained reactivity increase.
   5. Failure of the reactor make-up system. (1.0)

b. SDM is satisfied (.6) [illegible] or Until entry condition is satisfied. (.2) (0.8)

c. Required minimun flowrate per AOP 3566 = 35 gpm. (no margin accepted)

   Assume 10 gal 4% boric acid = 1ppm (given in AOP 3566) Nomograph indicated 900, but in an emergency situation there would be no time. AOP assumption reg

   100 ppm x 10 gal/ppm = 1000 gallons boric acid.

   1000 gallons / 35 gpm = approx. 30 minutes (+/- 5) (1.2)

REFERENCE
Millstone Procedures, AOP 3566.

ANSWER 4.06 (2.50)

a. (I1D1)(I1D1) = (I2D2)(I2D2) [0.5]

1200(2)(2)/(5)(5)=192 mr/hr

(192 mr/hr)(2 hr.)= 384 mrem [.75] (1.25)

b. 900 mrem + 384 mrem = 1284 mrem [0.25]

He exceeded normal 10CFR20 whole body limit of 1250 mrem.
If assume that NRC FORM 4 is complete, then limit of 3000 mrem is not exceeded. [1.0] (1.25)

NOTE: Answer to "b" is dependent on answer to "a" and graded accordingly.

REFERENCE
Millstone Procedures, HP 4902.

ANSWER 4.07 (3.50)

1. Main steam lines shut.
2. Main feed lines shut.
3. Blowdown lines shut.
4. Auxiliary feed lines shut.
5. Steam supply and warming valves to T/D AFW pump shut.
6. Mainsteam low point drains shut
7. S/G atmospheric dump valves shut [.5 ea] (3.5)

REFERENCE
Millstone 3 Emergency Procedures, EOP E-1, P 4

ANSWER 4.08 (3.50)

1. RCS subcooling based on core exit thermocouples. (0.5)

2. S/G pressures[.5]- stable or decreasing.[.25] (.75)

3. RCS hot leg temperatures[.5]- stable or decreasing.[.25] (.75)

4. Core exit TC's[.5]- stable or decreasing.[.25] (.75)

5. RCS hot leg temperatures[.5]- at saturation temperature for S/G pressure.[.25] (.75)

REFERENCE
Millstone 3 Emergency Procedures, EOP-35, ES-1.1, attachment A.

ANSWER 4.09 (1.50)

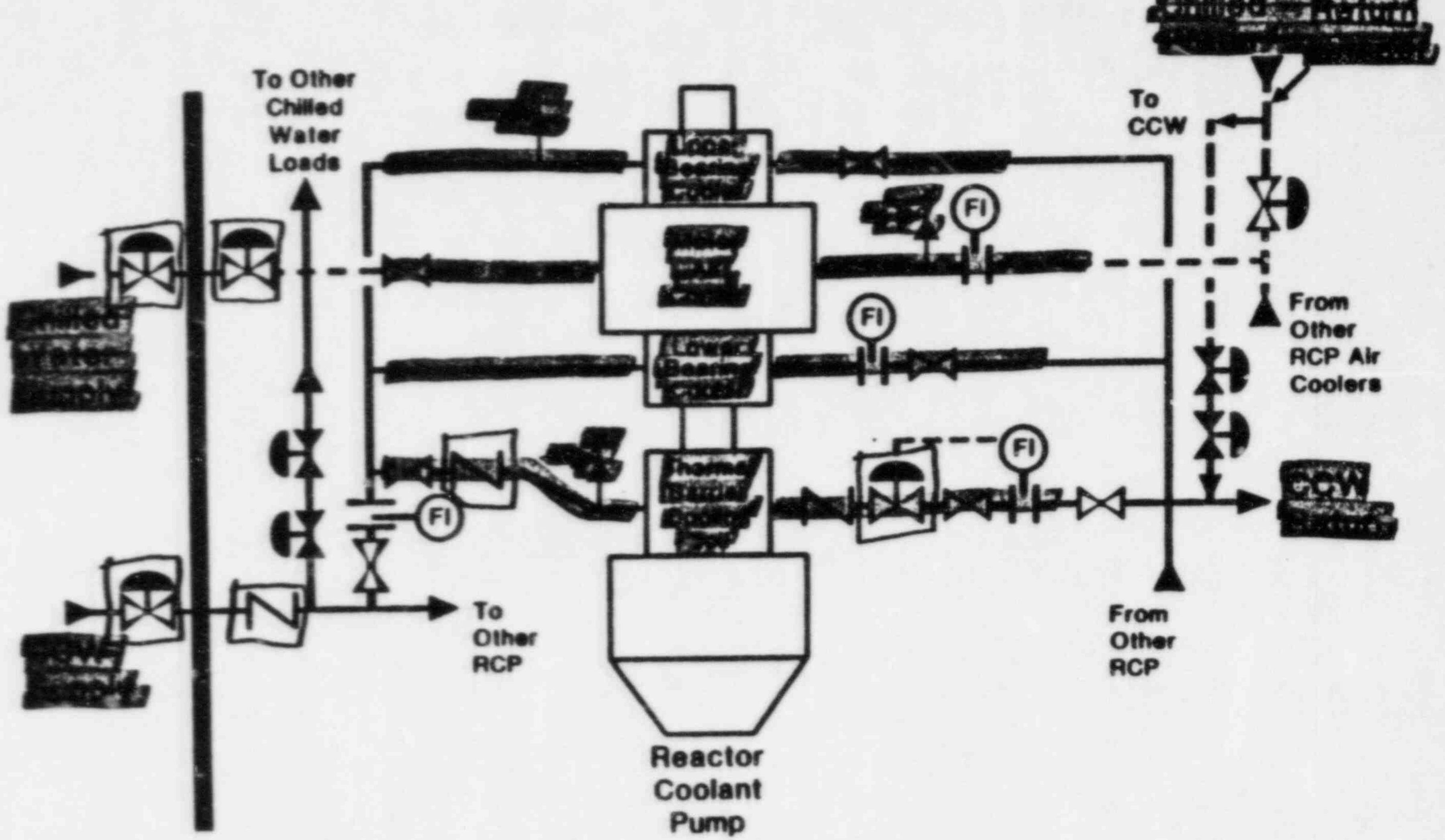
a. When at least one AC Emergency Bus is energized. [.5]

b. SI should be reset (to permit manual loading of the equipment). [.5]

c. To prevent injection of accumulator nitrogen into the RCS. [.5] Deleted (1.5) 1.0

REFERENCE
Millstone 3 Emergency Procedures, EOP 35 ECA-0.0, Pp 3,5,&9.

COOLING WATER TO THE REACTOR COOLANT PUMP



U. S. NUCLEAR REGULATORY COMMISSION
SENIOR REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: _MILLSTONE_3_____________

REACTOR TYPE: _PWR-WEC4_______________

DATE ADMINISTERED: _85/05/14_______________

EXAMINER: _ISAKSEN, P.____________

APPLICANT: ________________________

MASTER COPY

INSTRUCTIONS TO APPLICANT:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses 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	APPLICANT'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.00	________	________	5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.00	________	________	6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
25.00	25.00	________	________	7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.00	________	________	8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
100.00	100.00	________	________	TOTALS

FINAL GRADE ________________%

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

____
APPLICANT'S SIGNATURE

MASTER COPY

QUESTION 5.01 (2.00)

List the TWO factors which interact to result in the Doppler Fuel Temperature coefficient (FTC) being more negative at EOL AND briefly explain how each factor affects the value of FTC. (2.0)

QUESTION 5.02 (1.50)

According to Technical Specification bases 3/4.1.3, there are THREE reasons for the control rod insertion limits. NAME THE THREE REASONS. (1.5)

QUESTION 5.03 (3.00)

Unit 3 calculated Shutdown Margin is 10% delta k/k assuming the most reactive control rod worth is 1000 PCM. The Source Range count rate is 50 cps. Show all work and state any assumptions made for the following;

a. Determine the final count rate after the shutdown banks are fully withdrawn, assume the shutdown bank rod worth is 5600 PCM. (1.5)

b. Determine the final count rate after 100 ppm dilution of the RCS FOLLOWING a, above. (1.5)

QUESTION 5.04 (3.00)

a. Explain the effect of rod position on the Moderator Temperature Coefficient (MTC). Consider only rods inserted or withdrawn at power and disregard any effects of changes in boron concentration. (1.0)

b. Explain how and why the magnitude of MTC will vary with RCS temperature. (1.0)

c. What are two (2) effects that cause the Axial Flux Redistrition reactivity effect? (1.0)

(***** CATEGORY 05 CONTINUED ON NEXT PAGE *****)

QUESTION 5.05 (2.50)

a. Provide the full power equilibrium PCM values for the following poisons:

1. Xenon (0.25)

2. Samarium (0.25)

b. Provide TWO reasons for Xenon contributing more negative reactivity at full power than does Samarium. (2.0)

QUESTION 5.06 (3.00)

a. Explain the response of reactor power and Tave after 2 minutes of Emergency Boration at 100% power. Assume rod control is in manual. (1.5)

b. Explain the response of reactor power and Tave after 2 minutes of Emergency Boration at 10 -8 amps and no load Tave. (1.5)

QUESTION 5.07 (2.50)

Assume one RCP trips at 30% power without a reactor protection system actuation or a change in turbine load. Briefly discuss how each of the following parameters will change.

a. Flow in the operating Reactor Coolant Systems loops. (0.5)

b. The ratio of core flow compared to the total loop flow. (Core flow/Total loop flow) (0.5)

c. Reactor vessel delta-P. (0.5)

d. Actual Core delta-T. (0.5)

e. An (RCS) operating loop steam generator temperature. (0.5)

(***** CATEGORY 05 CONTINUED ON NEXT PAGE *****)

QUESTION 5.08 (2.00)

a. What is the advantage of condensate depression? (0.5)

b. What is the disadvantage of condensate depression? (0.5)

c. Determine the condensate depression if the condenser is operating at 4" Hg absolute and the condensate temperature is 115-F. (1.0)

QUESTION 5.09 (2.00)

a. Why is the limit for the overtemperature Delta T trip based on not reaching saturation conditions in the hot legs? (1.0)

b. Refer to figure 5-1 attached.

Operation within the limits of the 2000 psia curve from ~98% power- ~607-F Tave to ~120% power- 575-F Tave will prevent exceeding what specific minimum plant thermal criteria? (1.0)

QUESTION 5.10 (2.50)

A reactor operates at 100% power with RCS Tave at 570 degrees and a steam pressure of 770 psig. How much will Tave change if 25% of the Steam Generator tubes are plugged and 100% power and 770 psig steam pressure are maintained ? (2.5)

QUESTION 5.11 (1.00)

Why is the allowable RCS PRESSURE for a cooldown more limiting than for a heatup? (1.0)

(***** END OF CATEGORY 05 *****)

QUESTION 6.01 (3.00)

For each case below EXPLAIN the resulting method of reactor coolant system temperature control AND indicate the approximate final RCS Tavg. Assume all systems normal except as stated, no operator action, AND consider each case separately.

a. The normal steam pressure setpoint is reduced by 92 psi while in Hot Standby awaiting reactor startup. (1.0)

b. The train A steam dump selector switch is placed in 'off' while at 5% reactor power awaiting turbine startup. (1.0)

c. Train B reactor trip breaker fails to open upon a trip from 78% power. NOTE: Train A breaker opens. (1.0)

QUESTION 6.02 (3.00)

DELETED - (SUBSTITUTED 6.02 ATTACHED)

a. State the 5 interlocks that must be satisfied to open an RCS cold leg loop isolation valve. (2.0)

b. What are the reasons/bases for the interlocks in a, above? (1.0)

QUESTION 6.03 (3.00)

a. Assume the plant is shutdown at 500 F and 2000 psig. Will the Cold Overpressure Protection System (COPS) act to reduce plant pressure immediately if a loop Tcold instrument fails LOW? BRIEFLY EXPLAIN your answer, INCLUDING which train is affected, what action takes place, and any applicable setpoints. (2.0)

b. What is the purpose of the PORV interlock? (1.0)

QUESTION 6.04 (2.10)

a. What TWO Diesel Generator alarms will always stop the diesel engine? (1.0)

b. What will cause a Start Failure (SFR)? Be specific. (0.6)

c. What action is required (as a minimum) before another starting attempt can be made? (0.5)

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

(305 and 6.02)

(Q) a. State TWO interlocks associated with the RHR suction valves (8701A/B or 8702 A/B). (Include any applicable setpoints) (1.5)

b. The RCS is in a cold solid condition with cleanup via CVCS demineralizers in progress. Which component is utilized to control RCS pressure? (0.5)

---

c. State TWO conditions that would AUTOMATICALLY trip an RHR pump

(SRO only)

(A)

a. -Will not open unless RCS (loop WR) pressure is less than 425 psig
- Will automatically close at 700psig RCS (loop WR) pressure.
- Will not open unless valves 8804, 8812, 8837 and 8838 are closed. [2 required @ 0.75 each] (1.5)
[note - if provided separately, valves must be ~~counted~~ for full credit]

b. Letdown Pressure Control Valve (PCV-131) (0.5)

---

c. - RWST level (<36 feet) low with SI signal present (CAF)
(SRO only)
- Loss of power signal
- Motor protection signal L.O. Relay
- Buss differential L.O. Relay (Busses 34C or D)
[any 2 @ 0.5 each] (1.0)

Millstone 3 Volume I, Topic 1, Lesson 6, pages 7-10

Millstone 3 Volume I, Topic 2, Lesson 1, pages 12 and

QUESTION 6.05 (2.50)

The plant is operating at 30% power when the first stage impulse pressure transmitter PT 505 fails HIGH. Explain the effects of this failure and the sequence of events (control and protection) that lead to a reactor trip. Assume BOL, no operator action and initial plant conditions are in a normal/automatic configuration. (Setpoints not required). (2.5)

QUESTION 6.06 (2.40)

The plant is operating at 80% power when a Thot RTD fails high. EXPLAIN how this failure will affect the following. Consider each item independently. Assume no operator action and all control systems are in automatic.

a. Rod insertion limit setpoint (0.6)

b. Charging flow (initially) (0.6)

c. Control rod bank position (0.6)

d. Steam dump control system (0.6)

QUESTION 6.07 (3.00)

List the sequence of events (control and protection) that leads to a reactor trip when the controlling Pressurizer LEVEL channel (459) fails HIGH.

ASSUME- No operator action and initial plant conditions are in a normal/automatic configuration at 50% load. (Setpoints of control and protective events are not required.) (3.0)

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

QUESTION 6.08 (3.00)

Indicate whether the following statements are TRUE for OT Delta-T, OP Delta-T, or BOTH, (OT Delta-T and OP Delta-T) protection instruments.

1. Backup for the high neutron flux trip. (1.0)

2. Circuitry dynamically compensates for piping delays to the loop temperature detectors. (1.0)

3. Requires RCS pressure within the high and low reactor trip setpoints in order to be valid. (1.0)

QUESTION 6.09 (3.00)

a. What automatic actions affecting the Quench Spray System occur on decreasing RWST level, other than alarms? Include both the action and the associated level when they occur, (Numerical values not required). (1.0)

b. How is Sodium Hydroxide (NaOH) added to the Quench Spray System upon CDA? Please be specific. (1.0)

c. Why is NaOH added to the Quench Spray System? (0.5)

d. What is the effect of pressing the CDA reset pushbuttons too soon? (0.5)

(***** END OF CATEGORY 06 *****)

QUESTION 7.01 (3.50)

The following concern "Reactor Startup", procedure OP 3202.

a. What operator actions are required if criticality is NOT achieved when control rods reach the MAXIMUM rod position on the ECP? (1.0)

b. What additional operator action is required when diluting the RCS boron concentration more than 50 ppm? (0.5)

c. Are you permitted to adjust boron concentration while withdrawing the shutdown banks? Briefly EXPLAIN. (0.5)

d. How is proper group alignment and bank overlap determined during rod withdrawal for criticality? Be specific. (1.0)

e. While recording data at 10^{-8} amps, loop D Tavg is 535-F. What action is required if you have determined that loop D Tavg has been < 551-F for the last 15 minutes. Include any applicable time limitations. (0.5)

QUESTION 7.02 (3.00)

The following concern "Response to Nuclear Power Generation/ ATWS" procedure EOP FR-S.1.

a. How is a reactor trip verified? (1.0)

b. What operator action is required if the reactor fails to trip manually? (1.0)

c. How is a turbine trip verified? (0.5)

d. What condition must be met before boration can be terminated? (0.5)

(***** CATEGORY 07 CONTINUED ON NEXT PAGE *****)

QUESTION 7.03 (3.50)

The following concern "Reactor Coolant Pump Operation" procedure OP 3301D precautions.

a. Why should the RCP seal leakoff isolation valve be closed when RCS pressure is below 100 psia? (1.0)

b. How long can RCP operation continue if the seal leakoff isolation valve was shut due to #1 seal leakoff exceeding the limit for safe operation? (0.5)

c. List the RCP starting duty requirements. (1.0)

d. Why are these starting duty requirements necessary? (0.5)

e. When are you required to stop the RCP's if Reactor Plant component cooling water flow to the RCP's is lost? (0.5)

QUESTION 7.04 (3.50)

The following concern "Natural Circulation Cooldown" procedure EOP 35 ES-0.2.

a. What is the priority/order for attempting to restart RCP's? Why? (1.0)

b. What specific indications are used for monitoring RCS cooldown. (1.0)

c. How is RCS depressurization performed if normal letdown is NOT in service? (0.5)

d. What would be your primary indication of steam voiding in the reactor vessel? (0.5)

e. If auxiliary spray flow is required, HOW is auxiliary spray flow maintained/adjusted? (0.5)

(***** CATEGORY 07 CONTINUED ON NEXT PAGE *****)

QUESTION 7.05 (3.00)

The following concern "Steam Generator Tube Rupture" procedure EOP 35 E-3.

a. What is the criteria for determining if RCP's should be stopped? (1.0)

b. List FOUR ways the ruptured S/G can be identified. (1.0)

c. If a PZR PORV is used for RCS depressurization, the PRT may rupture and result in adverse containment conditions. What is the definition of adverse containment conditions? (1.0)

QUESTION 7.06 (3.00)

a. List FOUR conditions that require Immediate Boration as stated in AOP 3566. (2.0)

b. What operator actions are required to Immediate Borate, according to AOP 3566? (1.0)

QUESTION 7.07 (3.00)

The following concern "Radiation Work Permit Completion and Flow Control", procedure SHP 4912.

a. What are the TWO conditions which allow continuous HP personnel coverage to be substituted for a RWP? (1 0)

b. ~~How are exposures received during an entry into RWP areas (a, above) without an RWP recorded?~~ DELETED (~~0.5~~)

c. What is indicated/implied by your signature as SS/SCO on a RWP? 2.0 (~~1.5~~)

(***** CATEGORY 07 CONTINUED ON NEXT PAGE *****)

QUESTION 7.08 (2.50)

The following concern "Refueling Operations" procedure OP 3210B.

a. Briefly explain the exception to maintaining residual heat removal flow during core alterations, include any applicable time limitations. (1.0)

b. What is the basis/reason for maintaining 10.5 feet of water above the top of each fuel assembly during all handling operations. (0.5)

c. Who, by job position/title can approve/authorize loads greater than that of a fuel assembly and RCC to travel over irradiated fuel in the vessel with the head removed? (0.5)

d. What count rate indication requires suspension of fuel handling operations? (0.5)

(***** END OF CATEGORY 07 *****)

QUESTION 8.01 (3.50)

The following concern "Removing Equipment from Service for Maintenance, procedure OP 3250.

a. When is a system considered high pressure, high temperature? (1.0)

b. What is the required order of isolation of a high pressure system pump suction and discharge valves? (1.0)

c. Can a discharge check valve act as a pressure barrier? (0.5)

d. Maintenance is to be performed on a hydrogen system. The affected portion has been purged with six system volumes, isolated, vented and tagged. What additional action is required before allowing the work to be performed? (1.0)

QUESTION 8.02 (3.00)

a. What are the TWO conditions which allow the "operator at the controls" to leave the Surveillance Area of the Control Room during Mode 1 operation, according to ACP 6.01, Control Room Procedure? (2.0)

b. Which personnel, by job position/title can authorize taking the reactor critical? (1.0)

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.03 (3.50)

a. What is the MINIMUM number of operable excore channels indicating AFD outside the target band before AFD is considered outside its target band by Technical Specifications? (0.5)

b. Assume the plant is operating at full power and the Axial Flux Difference (AFD) has been outside the target band for the last 5 minutes. What are the TWO actions specified which you may choose between to meet the Technical Specification requirements? Include time limitations. (1.0)

c. Assume that it is 0310 on 05/13/85 and the plant is presently at 45% power. Considering the AFD penalty history below, at what date and time may power be increased above 50%? EXPLAIN. (Show all work.) Assume no deviation outside the band after 0310 on 05/13/85.

DATE	TIME WENT OUT OF BAND	TIME BACK IN BAND	POWER
05/12/85	0310	0318	85%
05/12/85	1557	1637	65%
05/13/85	0148	0310	45%

(2.0)

QUESTION 8.04 (2.50)

The following concern Department Instruction No. 3-OPS-3.07 on Valve Operation.

a. What are THREE requirements regarding manual seating (handwheel closure) of motor operated valves? (1.0)

b. Explain how manual valves should be checked closed AND open during performance of a valve lineup. (1.0)

c. What action must be performed prior to plant cooldown for a backseated valve, WHY is this action necessary? (0.5)

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.05 (3.00)

a. List FIVE of the six actions that only the Director of Station Emergency Operations (DSEO) or the Acting DSEO can authorize, as stated in EPIP 4010B. (2.5)

b. Where are the call back recorders located? (0.5)

QUESTION 8.06 (1.50)

If specific activity of the RCS is >1.0 uCi/gram dose equivalent I-131 for more than 48 hours during one continuous time interval, the plant must be placed in at least hot standby with RCS Tavg <500 F. What is the basis for reducing the RCS temperature to less than 500 F? (1.5)

QUESTION 8.07 (2.00)

List FOUR of the five Technical Specification bases/reasons for the MINIMUM temperature for criticality limitation. (2.0)

QUESTION 8.08 (2.50)

The following concern "Station Bypass/Jumper Control" procedure, ACP-QA-2.06B.

a. If a technical specification change is required and an unreviewed safety question is found to exist, before the installation of a jumper can be authorized, approval from _______ must be obtained. (Fill in the blank on your answer sheet) (0.5)

b. What condition allows the Shift Supervisor to grant exception to performing a second verification of a jumper installation? (0.5)

c. Who by job position/title must complete and sign the Assessment Section of the jumper-lifted lead-bypass control sheet? (1.0)

d. Under what conditions can a jumper be installed WITHOUT using procedure ACP-QA-2.06B? (0.5)

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.09 (1.50)

The concentration of the boric acid solution in the Refueling Water Storage Tank (RWST) shall be verified once per 7 days in accordance with Technical Specification 3.5.4. The chemist sampled the RWST on the following schedule. (All samples taken at 1200 hours.)

April 1 --- April 8 --- April 16 --- April 24 --- April 31

a. EXPLAIN why or why not surveillance time interval requirements were exceeded on April 16. (0.75)

b. EXPLAIN why or why not surveillance time interval requirements were exceeded on April 24. (0.75)

QUESTION 8.10 (2.00)

What action(s) (BOTH operational AND administrative) must be taken if the RCS-PRESSURE-Safety Limit is exceeded, in accordance with TS? Consider ALL Modes AND include applicable time limits in your answer. (2.0)

(***** END OF CATEGORY 08 *****)
(************* END OF EXAMINATION ***************)

EQUATION SHEET

$f = ma$

$v = s/t$

Cycle efficiency = (Net work out)/(Energy in)

$w = mg$

$s = V_o t + 1/2\ at^2$

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$

$A = A_o e^{-\lambda t}$

$PE = mgh$

$V_f = V_o + at$

$w = \theta/t$

$\lambda = \ln 2/t_{1/2} = 0.693/t_{1/2}$

$t_{1/2}eff = \dfrac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$W = v\ \Delta P$

$A = \dfrac{\pi D^2}{4}$

$\Delta E = 931\ \Delta m$

$\dot{m} = V_{av} A \rho$

$I = I_o e^{-\Sigma x}$

$\dot{Q} = \dot{m} C p \Delta t$

$\dot{Q} = UA \Delta T$

$Pwr = W_f \Delta h$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$P = P_o 10^{sur(t)}$

$P = P_o e^{t/T}$

$SUR = 26.06/T$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff1}) = CR_2(1 - k_{eff2})$

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$T = (\ell^*/\rho) + [(\beta - \rho)/\bar{\lambda}\rho]$

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\bar{\lambda}\rho)$

$\rho = (K_{eff} - 1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$M = 1/(1 - K_{eff}) = CR_1/CR_o$

$M = (1 - K_{effo})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-4}$ seconds

$\bar{\lambda} = 0.1\ \text{seconds}^{-1}$

$\rho = [(\ell^*/(T\ K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$I_1 d_1 = I_2 d_2$

$I_1 d_1{}^2 = I_2 d_2{}^2$

$P = (\Sigma \phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

$R/hr = (0.5\ CE)/d^2$(meters)

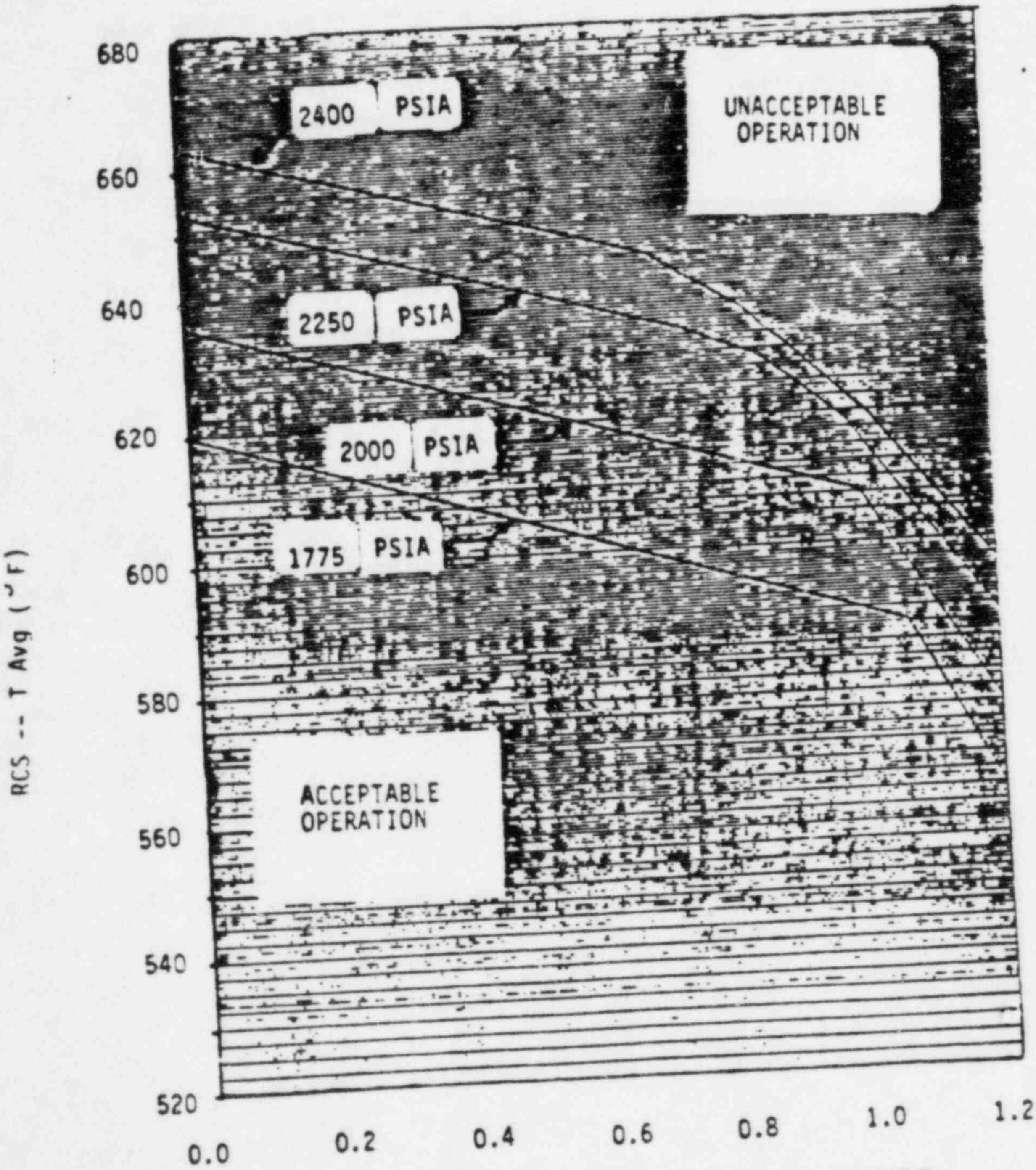
$R/hr = 6\ CE/d^2$ (feet)

Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
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 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 lbf/in.

Miscellaneous Conversions

1 curie = 3.7×10^{10} dps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf



(FIGURE 2.1-1)

REACTOR CORE SAFETY LIMIT – FOUR LOOPS IN OPERATION

ANSWERS -- MILLSTONE 3 -85/05/14-ISAKSEN, P.

MASTER COPY

ANSWER 5.01 (2.00)

1. BUILDUP OF PU240 [0.5] -- Causes an increase in the resonant absorption resulting in a MORE negative react. per degree temperature change [0.5]. (1.0)

2. CLAD CREEP/PELLET SWELL [0.5] -- Causes an increase in gap conductivity and with increasing power the pellet edge remains cooler at EOL resulting in a LESS negative FTC [0.5]. (1.0)

3. FISSION GAS BUILDUP - Decrease gap conductivity making FTC more negative (1.0)

[Any 2, 1.0 each]

REFERENCE
Millstone RTOC chapter 13, p. RT-13.3

ANSWER 5.02 (1.50)

1. Maintain adequate shutdown margin.

2. Limit worth of ejected control rod.

3. Ensure acceptable core power distributions. [0.5 each] (1.5)

REFERENCE
Millstone Technical Specification bases 3/4.1.3.

MASTER COPY

ANSWER 5.03 (3.00)

a. CR(f) = CR(I) [(1 - KI)/ (1 - Kf)]

Reactivity in core (I)= -10,000 pcm + (-1000 pcm) = -11,000 pcm
Reactivity in core (f)= -11,000 pcm + 5600 pcm = -5400 pcm

SDM = (1 - Keff)/Keff OR p = (Keff - 1)/Keff ; Keff =1/(1 - p)

KI = 1/(1 + 0.11) KI = 0.9009

Kf = 1/(1 + 0.054) Kf = 0.9488

$$CR(f) = 50 \text{ cps } \frac{(1-0.9009)}{(1-0.9488)} = 96.7 \text{ cps}$$ (1.5)

b. Assume Boron worth = 10 pcm/ppm

K(I) = 0.9488 CR(I) = 96.7 cps

Reactivity in core (I) = -5400 pcm + (100 ppm x 10 pcm/ppm)

= -5400 pcm + 1000 pcm = -4400 pcm

— K(f) = 1/(1 + 0.044) = 0.9579 [handwritten "0" inserted: 0.044]

$$CR(f) = 96.7 \times \frac{(1-0.9488)}{(1-0.9579)} = 96.7 \times 1.216 = 117.6 \text{ cps}$$ (1.5)

-0.5 for assumption error
-0.5 for incorrect formula usage

REFERENCE
Millstone RTOC, Chapter 8, pp RT-8.5-11

ANSWER 5.04 (3.00)

a. Withdrawing control rods tends to make the coefficient more positive. [0.5] Withdrawing rods effectively increases core size and less neutron leakage occurs. With less leakage any temperature change will result in a smaller reactivity change.[0.5] Will accept opposite affect if explanation of rod insertion. (1.0)

b. At higher temperatures the rate of density change becomes larger, increasing the magnitude of MTC, or vica versa. (1.0)

c. 1. The change in value of MTC with respect to temperature. (0.5)

2. The axial flux shift resulting from better moderation at cooler core inlet temperatures. (Resulting in non-uniform fuel burnup). (0.5)

REFERENCE
Millstone 3 RTOC, chapter 12, pp RT-12.2-4

ANSWER 5.05 (2.50)

a. 1. 2750 to 2850 pcm [0.25]

2. ~~925~~ 575 to ~~950~~ 600 pcm [0.25] (0.5)

b. 1. Higher fission yield of Xenon precursor [1.0]

2. Higher (thermal) absorption cross section for Xenon [1.0] (2.0)

REFERENCE
Millstone 3 RTOC, chapter 16, p. RT-16.2
Curve book, Sim form 3209-5 & 6

ANSWERS -- MILLSTONE 3 -85/05/14-ISAKSEN, P.

ANSWER 5.06 (3.00)

a. Power decreases initially due to the boron addition [0.5] the primary to secondary mismatch causes Tave to decrease [0.5] the decrease in Tave inserts positive reactivity and restores reactor power to a slightly lower than or the same as initial power [0.5] (possible low pressure trip, lo-lo Tave implies low pressure) (1.5)

b. Tave is determined by the amount of pump heat [0.5] and the steam dump setting thus it does not change [0.5] After the initial transient, power decreases at a -1/3 DPM rate to the multiplied source level [0.5] (1.5)

REFERENCE
WNTC Transient and Accident Analysis, chapter 3, p. 3.16

ANSWER 5.07 (2.50)

a. Increase - due to reduction in back pressure from other loops.
b. Decrease - due the backflow in the 4th loop.
c. Decrease - due to less flow resistance across the core.
d. Increase - less flow = less heat removal and higher exit temperature.
e. Decrease - increased delta T means lower Tc and since S/G temp. is always slightly < Tc, S/G temperature is less.
[0.25 for each response; I,D and Explan.] (2.5)

REFERENCE
Transient Analysis, chapter 4, p. 4.17

ANSWER 5.08 (2.00)

a. Increases NPSH (cavitation) (0.5)

b. Reduced efficiency (0.5)

c. 4" Hg = 1.9632 psia[0.25] Tsat = 125-F[0.5] (-0.25 if table 2 vs table 1 is used)
125-115 = 10-F condensate depression[0.25] (1.0)

REFERENCE
GP HT&FF Sect II, Part B, p. 155-159, 182-133; Sect. III Part B, p. 319-320

ANSWER 5.09 (2.00)

a. OT Delta T uses Thot and Tcold inputs to measure the delta T across the core. Once the core exit reaches saturation the enthalpy rise can no longer be equated to the delta T across the core and therefore the OT Delta T trip no longer provides adequate protection. (partial credit for discussion of disadvantages of saturation conditions) (1.0)

b. Prevents exceeding the DNBR limit [0.75] of 1.3 [0.25]. (1.0)

REFERENCE
Technical Specifications p. A-8 & 9; and Bases B 2-1.
Fig. 2.1-1

ANSWER 5.10 (2.50)

Steam Generator Heat Transfer = Q=UA(Tave-Tstm) [0.5]

Q, U, and Tstm remain constant, therefore [0.5]

A1(Tave1 - Tstm) = A2(Tave2 - Tstm) [0.5]

Given: A2 = 0.75 A1

From steam tables: Tsat for 785 psig =516 degrees [0.5]

A1(570 - 516) = .75A1(Tave2 - 516)

Tave2 = 587.8 (accept 587-588) [0.5] (2.5)

REFERENCE
GP HTFF, Sec. II, part B, chapter 2.

ANSWER 5.11 (1.00)

Because during a C/D the inner wall of the Reactor Vessel experiences a tensile stress [0.5] which increases the total stress on the inner wall [0.5]. also accepted similar correct answer for heating if proper temperature range indicated ie 300°F (1.0)

REFERENCE

Technical Specifications 3/4.4.9 and Bases.

ANSWER 6.01 (3.00)

a. The normal steam pressure setpoint of 1092 psig maintains Tavg at ~557 F, a decrease in the setpoint to 1000 psig would cause the dumps to open and cool Tavg to ~550 F where the P-12 interlock would close all steam dumps (Note: 0.25 credit given for correct conversion to Tsat ~547 F) (1.0)

b. Secondary pressure would rise to the setpoint of the secondary atmospheric relief valves [0.5] which would maintain pressure at 1125 psig [0.25] and primary temperature 560 +/-1 F [0.25]. (1.0)

c. A signal by the Load Rejection controller [0.5] would control primary temperature at "No Load" Tref +2 F deviation (dead band) (559 F) [0.5]. (1.0)

REFERENCE
Millstone 3 SD Topic 5, Lesson 2, Steam Dump p. 11-19.

ANSWER 6.02 (3.00) deleted - substituted with attached 6.02

a. 1. Isolated hot leg wide range temperature must be within 5 Deg-F of auctioneered high wide range Thot.

2. Isolated cold leg wide range temperature must be within 5 Deg-F of auctioneered high wide range Tcold.

3. Hot leg isolation valve must be open.

4. Bypass isolation valve must be open.

5. Sufficient flow through the bypass/mixing line (200 gpm) (2.0)

b. To prevent reactivity additions from either cold and/or dilute water injected into the RCS and thermal shock considerations. (1.0)

REFERENCE
Millstone 3, Vol 1, Topic 1, Lesson 1, p. 15-16.

ANSWER 6.03 (3.00)

a. - NO PRESSURE REDUCTION; The Train A PORV only opens on auctioneered Thot that it provides. [0.5]
- Auctioneered Tcold inputs to Train B. [0.25]
- If the COPS is ARMED the PORV (456) will open OR if assumed not ARMED then no pressure reduction occurs[1.0] ~~CAF~~ (2.0)

b. It prevents depressurization of the RCS past the interlock setpoint (2200 psia) if a pressure channel selected to a PORV fails high. (1.0)

REFERENCE
Millstone 3 Vol 4, Topic 6, Lesson 6&7, p. 12,14-16,pp-8,35,pp-9.

ANSWER 6.04 (2.10)

a. 1. Low lube oil pressure.
2. Engine overspeed. (1.0)
3. Generator differential. [Two required, 0.5 each]

b. The cranking time limit relays time out (7 secs) before the low speed contacts energize the low speed relay. (0.6)

c. Operation of the engine shutdown reset. (0.5)

REFERENCE
Millstone 3, Vol 1, Diesel Generator and Support Systems, p. 42,50,51.
S+W DWG No. 12179-LSK-24-9.3J AND LSK-24-9.2D.

ANSWER 6.05 (2.50)

Control rods will automatically move outward [0.5] due to temperature error and power mismatch adding positive reactivity [0.5]. With a small MTC, reactor power will rise rapidly [0.5] causing a (C-2) overpower rod stop [0.5] and power overshoot results in a high neutron flux trip [0.5]. (2.5)

REFERENCE
Millstone 3, Vol. 5, Topic 8, Lesson 4, I&C failure analysis, Page 43.

ANSWER 6.06 (2.40)

a. Raises the limit, because high dT indicates a higher power. (0.6)

b. Increases to raise pressurizer level to 100% program, because of the higher Tave. (0.6)

c. Rods move in, because of the Auct. Tave/Tref mismatch. (0.6)

d. No effect, the demand signal is present (Tave/Tref) but there is no arming signal. (0.6)

REFERENCE
Milstone 3, Vol. 4, Topic 6, Lesson 7, Pages 25, 26,
Lesson 2, Pages 46, 47, RS-3,5,
Lesson 3, Pages 26, 27, RI-21,
Vol. 3, Topic 5, Lesson 2, Page 12

ANSWER 6.07 (3.00)

1. Backup heaters energize [0.4]

2. Charging flow to minimum (FCV 121 min. open position) [0.6]

3. Pressurizer level decreases and letdown isolation (LCV-460 and orifice valves) [0.7]

4. Backup and control heaters cutout [0.4]

5. Reactor trip on high pressurizer level [0.9] (3.0)

REFERENCE
Millstone 3, Vol. 5, Topic 8, Lesson 4, Pages 61, 62.

ANSWER 6.08 (3.00)

1. OP Delta-T

2. BOTH

3. OT Delta-T [1.0 each] (3.0)

REFERENCE
Millstone 3, Vol. 3, Topic 6, Lesson 8, Pages 7-14.

ANSWER 6.09 (3.00)

a. 1. Quench spray pump discharge valve closes - RWST low-low-low level.
   2. Pumps auto stop - RWST empty level. (1.0)

b. The CAT isolation valves open on CDA [0.5] allowing gravity flow to the suction lines of each pump [0.5]. (1.0)

c. (To aid in the removal and retention of iodine.) maintain proper pH of containment sump (7.0-7.5) to minimize corrosion of systems/components. (0.5)

d. Resets and blocks the CDA signal (block signal clears when high-3 pressure signal clears ,<10 psig). (0.5)

REFERENCE
Millstone 3 ,Vol 3, Topic 3, Lesson 5, p. 8,10,11,20,23,24; Technical Specification Bases 3/4.6.2.3.

ANSWER 7.01 (3.50)

a. 1. Terminate the startup by fully inserting all control rods.
   2. Determine RCS boron concentration and recalculate an ECP. (1.0)

b. Energize PZR heaters (to induce spray flow). (0.5)

c. No, with the reactor in the source range positive reactivity must not be changed by more than one controlled method at a time. (0.5)

d. Rod motion is stopped (every 50 steps) and bank demand position is compared to digital position indication. (1.0)

e. Be in Hot Standby within the next 15 minutes. (partial credit given if candidate assumed failed instrument and correct response for assumption given). (0.5)

REFERENCE
OP 3202, Pages 4, 7-10.

ANSWER 7.02 (3.00)

a. 1. Rod bottom lights lit.
   2. Reactor trip and bypass breakers open.
   3. Digital rod position indicators at zero.
   4. Neutron flux decreasing. (1.0)

b. Trip Bus 32B and 32N load center supply breakers. (1.0)

c. All turbine stop valves closed. (0.5)

d. After adequate shutdown margin is obtained (during subsequent actions). (0.5)

REFERENCE
EOP 35 FR-S.1, Pages 3, 6.

ANSWER 7.03 (3.50)

a. To prevent contaminants from the RCP seal leakoff line from being forced back into the RCP seal chamber. (1.0)

b. 30 minutes (0.5)

c. (1. Only one RCP started at a time) [0.3]
   2. Two successive starts are permitted, provided the RCP coasts to a stop between starts. [0.2]
   3. A third start is permitted after [0.3] standing idle for 45 minutes ✓ [0.1] or after running for 20 minutes. [0.1] (1.0)

d. To prevent damage to the RCP motor windings. (0.5)

e. Before RCP (upper or lower) bearing temperatures exceed 190-F. (0.5)

REFERENCE
OP 3301D Page 5.

ANSWER 7.04 (3.50)

a. 2, 1 then 3 or 4, to provide normal PZR spray. (1.0)

b. 1. Core exit TC's
   2. RCS hot leg temperatures
   3. RCS subcooling (based on core exit TC's) (1.0)
   (also accepted)
   - S/G pressure/RCS temperature relationships
   - core ΔT

c. Use one PZR PORV. (0.5)

d. Unexpected large variations in PZR level, or RVLMS < 100% (0.5)

e. (Auxiliary spray flow is maintained and) charging flow is throttled as necessary. (FCV 121) (0.5)

REFERENCE
EOP 35, ES-0.2, F-0.6.

ANSWER 7.05 (3.00)

a. 1. At least one charging or SI pump running.
   2. RCS pressure < 1410 psia (1738 for adverse containment). (1.0)

b. 1. Unexpected increase in S/G narrow range level.
   2. High S/G sample radiation.
   3. High S/G steamline radiation.
   4. High S/G blowdown line radiation. (1.0)

c. Containment pressure (>15 psia), Hi-1g radiation >1000 R/hr. (1.0)

REFERENCE
EOP 35 E-3, Pages 3,4,13; F-0.5, Generic INSTR. 0041V P.21.

ANSWERS -- MILLSTONE 3 -85/05/14-ISAKSEN, P.

ANSWER 7.06 (3.00)

a. 1. Control rod bank height below the rod bank low-low limit alarm setpoint (with the reactor critical).

2. Failure of one or more control rod clusters to fully insert following a reactor trip or shutdown (indicated by digital rod position indication system.

3. Uncontrolled cooldown of the reactor coolant following a reactor trip or shutdown (Tavg decreasing in an uncontrolled manner as indicated by two of the loops low-low Tavg status lights).

4. Uncontrolled or unexplained reactivity increase (indicated by abnormal control rod bank insertion, increasing Tavg or increasing nuclear power).

5. Failure of the Reactor Makeup Control System to the extent that the makeup system must be bypassed to accomplish boration of the Reactor Coolant System.
[Four required 0.5 each] (2.0)

b. 1. START a boric acid transfer pump.

2. OPEN the Emergency Boration Supply to charging pump suction.

3. Verify Emergency Boration flow of 35 gpm setpoint [0.2] or greater.

(4. Increase letdown and charging flow as necessary.) (1.0)

REFERENCE
AOP 3566, Pages 2 and 3.

ANSWER 7.07 (3.00)

a. 1. Very short duration tasks (i.e. examination of a work area, retrieve tools, etc).
   2. An emergency which threatens personnel or plant safety. (1.0)

b. On the weekly dosimeter record form (incidental exposure sheet). (0.5) DELETED

c. 1. Approval of the RWP.
   2. No plant evolutions are planned which could change the radiological conditions in the area.
   3. The plant is not jeopardized by work indicated on the RWP.
   4. To notify HP whenever an evolutions planned/taken place that would change radiological conditions. (1.5) 2.0

REFERENCE
SHP 4912, Pages 3 and 7.

ANSWER 7.08 (2.50)

a. Flow may be suspended for up to 1 hour per 8 hour period during performance of core alterations in the vicinity of the vessel hot legs. (1.0)

b. To ensure the gamma dose rate at the water surface is within limits (2.5 mrem/hr). (0.5)

c. Shift Supervisor. (0.5)

d. Excessive or unanticipated count rate multiplication (i.e. doubling). (0.5)

REFERENCE
OP 3210B, Pages 5-7.

ANSWER 8.01 (3.50)

a. > 500 psig, 200-F (1.0)

b. Discharge first then suction. (1.0)

c. No (0.5)

d. Chemistry samples the immediate area and inside closed volumes for explosive concentration of hydrogen. (1.0)

REFERENCE
OP 3250, Pages 4-6.

ANSWER 8.02 (3.00)

a. 1. To verify the receipt of an annunciator alarm.
   2. To initiate corrective actions resulting from an emergency. (2.0)

b. Station Superintendent, Unit Superintendent and Operations Supervisor. (1.0)

REFERENCE
ACP 6.01, Pages 3, 6, 7; OP 3202

ANSWER 8.03 (3.50)

a. 2 (0.5)

b. Within 15 (or next 10) minutes [0.2] either.
   1. Restore the indicated AFD to within the target band [0.4], or
   2. Reduce the thermal power to <90% of rated thermal power. [0.4] (1.0)

c. Accumulated penalty over the past 24 hours is 89 minutes. [1.0] The penalty will be reduced to 60 minutes at 1618 minutes on 05/13/85 and then power may be increased. [1.0] (2.0)

85%	0318-0310	=	8			[0.25]
65%	1637-1557	=	40			[0.25]
45%	0310-0148	-	82/2	=	41	[0.5]
					--	
					89 min. total penalty	

05/13/85, from 1557; 81 min left -60 - 21 min -> 1618 05/13/85

REFERENCE
TS; 3.2.1

ANSWER 8.04 (2.50)

a. 1. Shift Supervisor approval.
   2. Notification to Operations Supervisor/Duty Officer
   3. Identification on Shift Turnover Sheet.
   4. Cheater bars must not be used. [3 required, 0.33 each] (1.0)

b. Closed - by going to close until seated. [0.4]
   Opened - by partially closing, opening until seated then closing one-quarter turn. [0.6] (1.0)

c. Valve taken off its backseat to prevent undue stresses to the valve. (0.5)

REFERENCE
DI-3-OPS-3.07, Pages 3, 4, 6.

ANSWER 8.05 (3.00)

a. 1. Changing incident classification and posture code level.
   2. Recommending protective actions for offsite authorities.
   3. Ordering assembly or evacuation.
   4. Authorizing emergency reentry into radiological areas for repair, or search and rescue.
   5. Authorizing radiological exposures in excess of NNECo or 10 CFR 20 exposure limits.
   6. Authorizing contaminated personnel to leave the station. [5 required, 0.5 each] (2.5)

b. Unit 1 Control Room. (0.5)

REFERENCE
EPIP 4010A,B.

ANSWER 8.06 (1.50)

If a tube rupture were to occur, [0.5] a release will be prevented ~~[0.5]~~ since the S/G atmospheric relief setpoint will be above the corresponding saturation pressure for 500 F. [1.0] (1.5)

REFERENCE
Tech. Spec. 3/4.4.8 and Bases.

ANSWER 8.07 (2.00)

1. MTC in analyzed range.
2. Protective instrumentation within normal operating range.
3. P-12 interlock above its setpoint.
4. PZR is capable of operable status with a steam bubble.
5. Reactor vessel above minimum RT_{NDT} temperature.

[4 required, 0.5 each] (2.0)

REFERENCE
Tech. Spec., Pages B 3/4 1-2.

ANSWER 8.08 (2.50)

a. NRC (0.5)

b. If the second verification would result in significant radiation exposure. (0.5)

c. SS, Duty Officer, (PORC) (1.0)

d. If identified and controlled in another approved procedure. (0.5)

REFERENCE
ACP-QA-2.06B, Pages 6, 8, 10, 12.

ANSWER 8.09 (1.50)

a. Interval requirement not exceeded [0.25]. Eight days does not exceed 1.25 times the specified interval [0.5]. (0.75)

b. Interval requirement exceeded [0.25]. The last 3 consecutive intervals exceed 3.25 times the specified interval [0.5]. (0.75)

REFERENCE
Tech. Spec., Page 3/4 0-2.

ANSWER 8.10 (2.00)

Modes 1&2-- Be in HSB with pressure within limits in one hour. (0.6)

Modes 3,4,5-- Reduce pressure to within limit in 5 minutes. (0.9)

All Modes-- Notify the NRC Operations Center immediately (within one hour). (0.5)

REFERENCE
Tech. Spec., Pages 2-1, 6-16.