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

EXAMINATION REPORT NO.: 86-10 (OL)

FACILITY DOCKET NO.: 50-423

FACILITY LICENSE NO.: NPF-49

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

FACILITY: Millstone Nuclear Power Station Unit 3

EXAMINATION DATES: March 31, 1986 to April 4, 1986

CHIEF EXAMINER: S Barber 6/23/86
S. Barber, Reactor Engineer (Examiner) DATE

REVIEWED BY: RM Keller 6/23/86
R. M. Keller, Chief DATE
Projects Section 1C

APPROVED BY: HB Kister 7/2/86
H. B. Kister, Chief DATE
Projects Branch No. 1

SUMMARY: Oral, written and simulator exams were administered to three reactor operator and nine senior reactor operator candidates. All reactor operator candidates passed all portions of their examinations and will be issued licenses. Six senior reactor operator candidates passed all portions of their examination and will be issued licenses. Of the three senior reactor operator candidates that did not pass: 1 failed the written only, 1 failed the simulator and oral only and 1 failed the written, oral and simulator.

Lack of proper examination security continues to be a problem.

REPORT DETAILS

TYPE OF EXAMS: Initial

EXAM RESULTS:

	RO Pass/Fail	SRO Pass/Fail
Written Exam	3/0	7/2
Oral Exam	3/0	4/2
Simulator Exam	3/0	4/2
Overall	3/0	6/3

I. CHIEF EXAMINER AT SITE: D. Cr /S. Barber, NRC

II. OTHER EXAMINERS: J. Hannon, NRC
R. Keller, NRC
F. Jaggar, INEL

III. Summary of generic strengths or deficiencies noted during the operating exam:

A. Candidates were unable to explain the use and construction of area and process Radiation Monitoring System.

B. Candidates with Millstone 2 experience were unable to properly explain the operation of the Millstone 3 rod control system and the cold leg recirculation flow path.

IV. Simulator Deficiencies:

A. The A Instrument Air Compressor can not be placed in constant run unless the B compressor is failed.

B. The Containment CAR fan monitor (CMS-22) alarmed for no reason during a steam generator tube rupture.

V. Generic weaknesses noted during the grading of written examinations.

A. RO candidates were unable to adequately explain the following:

1). How core delta T is affected on a loss of natural circulation.

2). The flowpaths for Reactor Coolant Pump #1 seal leakoff during a safety injection.

3). The automatic actions that result from high activity due to a fuel drop accident.

4). Red path entry conditions for a Response to Loss of Secondary Heat Sink, FR-H.1.

B. SRO candidates were unable to adequately explain the following:

1). The design attributes that cause core uncovery to be more likely for a cold leg break than for a hot leg break.

2). The proper use of plant pump data to estimate flowrates at a given pressure.

3). Conditions that require entry into Inadequate Core Cooling Procedures.

4). The reasons for requiring a maximum reactor vessel venting time calculation.

5). How to determine that Technical Specification leakage limits are being exceeded.

6). The proper interpretation of the operability of the Reactor Coolant System's power operated relief valves.

VI. Training/Reference Material:

The reference material supplied by the facility did not contain:

- Operating Procedure Index
- Emergency Procedure Foldout Page
- Critical Safety Function Status Trees
- Simulator Initial Condition List

VII. Personnel Present at Exit Interview:

NRC Personnel
D. Coe, Reactor Engineer (Examiner)
J. N. Hannon, Section Leader, Operator Licensing
J. T. Shedlosky, Senior Resident Inspector
J. Grant, Resident Inspector

NRC Contractor Personnel
F. S. Jagger, Contract Examiner

Facility Personnel
W. D. Romberg, Station Superintendent
J. D. Crockett, MP3 Superintendent
H. F. Haynes, Manager, Operator Training
R. G. Stotts, MP3 Training Supervisor

VIII. Summary of NRC Comments made at exit interview:

The chief examiner reviewed the number and type of examinations administered during the previous week and presented generic weaknesses observed during the simulator and oral examinations.

Examination security was lax. A security officer passed through a barrier to use a restroom reserved for the candidates. This was the third occurrence of this type. In addition, personnel entered and exited the simulator without prior approval. The licensee committed, in a letter dated June 18, 1986, to station a security guard during the written examination and to post conspicuous signs during the simulator examination. These actions should be adequate to ensure examination security.

Initially security access to the plant was delayed. However, attention by management improved access and reduced delays in later entries into the plant.

IX. Examination Review

An examination review was conducted after the completion of all operating exams. Items from Attachment 3 were discussed on a line item basis. All items were considered during grading but not all items resulted in a change to the master exam. Attachment 4 details the significant changes to the examinations.

Attachments:

1. Written Examination and Answer Key RO
2. Written Examination and Answer Key SRO
3. Facility Comments on Written Examinations
4. Changes to Written Examinations.

Attachment 1

Reviewers

Mark Hall
Mike Leviton
Warren Potter
Tim McDonald

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: MILLSTONE 3

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 86/04/01

EXAMINER: JAGGAR, F.

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	________	________	1.	PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.00	________	________	2.	PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
25.00	25.00	________	________	3.	INSTRUMENTS AND CONTROLS
25.00	25.00	________	________	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 (1.00)

a. The reactor coolant pumps require about 30% more power to operate in cold shutdown <200 F than at 530 F (hot shutdown). Why are the power requirements different for each condition? (0.5)

b. If the VELOCITY of the fluid is the SAME at 200 F and at 530 F, will the MASS FLOW RATE also be constant at these two different conditions? Explain. (0.5)

QUESTION 1.02 (3.00)

After operating in natural circulation for 2 hours, a complete loss of natural circulation flow occurs. How will the following parameters be affected initially (INCREASE, DECREASE, or NO CHANGE)? Briefly explain your answer. (assume no further operator action)

a. Core delta T

b. Core thermocouple temperature

c. Steam generator pressure

~~d. RCS flow~~

QUESTION 1.03 (.70)

Following a reactor trip from 100% power, how long should it take before the source range instrumentation would be automatically energized? (Choose the one most correct answer).

a. 9 minutes.

b. 12 minutes.

c. 18 minutes.

d. 23 minutes.

e. 55 minutes.

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

QUESTION 1.04 (3.00)

Explain HOW and WHY the following parameters change as reactor power level increases at MOL.

a. Fuel Temperature Coefficient (delta pcm/ F)

b. Moderator Temperature Coefficient

QUESTION 1.05 (3.00)

Briefly explain how the reactivity worth of a control rod is affected by each of the following?

a. Moderator temperature increases.

b. Reactor power increases.

c. Other control rods.

d. The radial position in the core.

QUESTION 1.06 (1.50)

Compare the effects of a 0.5% positive reactivity addition to a subcritical reactor if the reactor was slightly subcritical [shutdown margin = 1%] as compared to greatly subcritical [shutdown margin = 5%] for the following two items. (No calculations are required).

a. The change in count rates.

b. The time to reach a stable count rate.

QUESTION 1.07 (2.00)

After operation at 100% power for several weeks near the end of cycle, power is reduced to 75% using rods only.

Describe the Xenon transient in terms of production and removal rates from the time power reaches 75% over the next 40 hours. Include the effects from each production and removal terms.

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

QUESTION 1.08 (1.50)

a. If the reactor is operating in the power range, how long will it take to raise power from 20% to 40% with a +0.5 DPM Startup rate?

1. 12 sec.

2. 21 sec.

3. 36 sec.

4. 54 sec.

b. How long will it take to raise power from 40% to 60% with the same +0.5 DPM Startup rate?

1. 12 sec.

2. 21 sec.

3. 36 sec.

4. 54 sec.

QUESTION 1.09 (2.00)

a. Describe the relationship between discharge flow rate and the following, for a centrifugal pump.

1. Pump speed.

2. Pump discharge head. (1.0)

b. Define the following terms.

1. Pump Runout

2. Shutoff head. (1.0)

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

QUESTION 1.10 (2.00)

a. Since fuel temperature cannot be measured, what power distribution limit at Millstone prevents exceeding the fuel temperature limit? (0.5)

b. What limit must be observed to prevent exceeding the clad temperature limit? (0.5)

c. Why will the clad surface temperature peak towards the top of the core rather than the location of peak actual heat flux? (1.0)

QUESTION 1.11 (1.80)

True or False

a. The production of Xenon from Iodine is FASTER than the decay of Xenon to Cesium.

b. As a result of an increase in power from equilibrium Xenon conditions, Xenon concentration initially DECREASES.

c. SLOWING the rate of a power decrease LOWERS the height of the resultant Xenon peak.

QUESTION 1.12 (2.00)

The control rods must be maintained above the Rod Insertion Limits during power operation.

a. List THREE reasons for the Rod Insertion Limits.

b. HOW and WHY does the limit change as power is increased?

QUESTION 1.13 (1.50)

During a cooldown of the RCS using RHR, assuming a constant decay heat rate, how will RHR flow through the heat exchanger have to be adjusted to maintain a constant cooldown rate from 350 F to 150 F? Explain your answer.

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

QUESTION 2.01 (1.00)

Indicate whether the following statements are TRUE or FALSE concerning the Reactor Protection system.

a. The 109 % Power Range nuclear flux trip does not provide protection until the low range trip is manually blocked.

b. The Intermediate Range high nuclear flux trip can be blocked if 1 of 4 Power Range channels is above 10 %.

QUESTION 2.02 (2.00)

a. With the Reactor Plant Component Cooling Water Pump Control Switch in the "AUTO" position, what are three conditions which will automatically start the standby pump? (setpoints not required.) (0.75)

b. Under what condition will component cooling water automatically be isolated to the RCP's? (0.5)

c. What is the approximate (+/- 50 psig) setpoint of the CCW relief valve downstream of the thermal barrier heat exchanger? Why is it set at this value? (0.75)

QUESTION 2.03 (1.50)

Describe how the 120 VAC System ensures power is available to the Vital Instrument AC panel (VIAC-1) under the following conditions.

a. Inverter (INV-1) failure.

b. Rectifier failure.

c. Loss of normal 480 VAC input to the inverter.

QUESTION 2.04 (2.00)

a. State the power supplies to each of the motor-driven AFW pumps. (0.5)

b. From which steam headers does the turbine driven AFW pump receive its steam supply? (0.5)

c. State the signals, logic, and coincidence that will cause each of the AFW pumps to start automatically. (1.0)

QUESTION 2.05 (1.50)

a. Briefly describe the system used to detect leakage past the Reactor Vessel head O-rings. A brief drawing may be used. Include in your description the NORMAL positions of the valves during power operation. (1.5)

QUESTION 2.06 (3.00)

a. Briefly describe what happens to No. 1 RCP shaft seal when the injection pressure increases by 50 psig over normal pressure. (1.5)

b. What are the flowpaths for the RCP #1 seal leakoff during a safety injection? (1.0)

c. What two parameters determine the differential pressure across the RCP #1 seal? (0.5)

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

QUESTION 2.07 (2.00)

State the valve positions (OPEN or CLOSED) for the following RHR System Valves for the indicated emergency conditions. Place your answers on your answer paper.

COMPONENT	INJECT.	COOLDOWN	CL RECIRC	HL RECIRC	
a. RWST Suction Valves					0.5 ~~(0.4)~~
~~b. Sump Suction Valves~~ 0					~~(0.4)~~ 0
c. Hot Leg Suction Valves					0.5 (~~0.4~~)
d. Cold Leg Discharge Valves					0.5 (~~0.4~~)
e. Hot Leg Discharge Valves					0.5 (~~0.4~~)

QUESTION 2.08 (2.50)

The following pertain to the plant air systems.

a. When an Instrument Air Compressor control switch is in the "AUTO" position, at what receiver pressure will the compressor start and stop? (1.0)

b. ~~In the event of a loss of Containment Instrument Air Compressors, how will air be supplied to the Containment Air System? Include applicable setpoints.~~ 0 (~~1.0~~) 0

c. True or False

Unit 3 Instrument Air System may be cross-connected with the Unit 2 Instrument Air System via a spool piece. (0.5)

QUESTION 2.09 (1.00)

Briefly describe how the Charging Pump and Safety Injection Pump Net Positive Suction Head (NPSH) is maintained during ECCS Cold Leg Recirculation.

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

QUESTION 2.10 (2.50)

a. How long after a Containment Depressurization Actuation (CDA) signal does the Containment Recirculation System (CRS) actuate? (0.5)

b. What is the reason for the time delay? (0.5)

c. After the required time delay the CRS enters MODE I and later MODE II. Describe the difference between CRS MODE I and MODE II. (1.5)

QUESTION 2.11 (2.00)

Briefly describe how the letdown pressure control valve (PCV-131) performs its function during both normal and solid plant operations.

QUESTION 2.12 (2.00)

State two functions of the Containment Recirculation System (CRS).

QUESTION 2.13 (2.00)

Which of the four reactor trip switchgear breakers (RTA, RTB, BYA, and BYB) receive a trip signal upon each of the following occurrences.

a. In Mode 1, train B shunt trip signal is received from the control room switch.

b. In Mode 1, an automatic reactor trip signal is received from Train A.

c. In Mode 3 with the shutdown banks fully withdrawn, both bypass breakers are connected and closed, simultaneously.

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

QUESTION 3.01 (2.00)

a. What safety limits are the following RCS trips designed to protect against?

1. Overtemperature Delta T (0.5)
2. Overpower Delta T (0.5)

b. Why does the Overtemperature Delta T circuit have pressure as an input whereas the Overpower Delta T circuit does not? (1.0)

QUESTION 3.02 (1.50)

a. Why is "Bank Overlap" desired? (0.75)

b. BRIEFLY EXPLAIN why the Rod Control Startup Reset Switch is not used when recovering from a dropped control rod at power. (0.75)

QUESTION 3.03 (.70)

Which of the following expresses the combined error signal used by the Reactor Control System to generate rod motion? NOTE: Outward rod motion is positive.

a. (Impulse Pressure - Nuclear Power) + (Tref - Tavg)

b. (Nuclear Power - Impulse Pressure) + (Tref - Tavg)

c. (Nuclear Power - Impulse Pressure) + (Tavg - Tref)

d. (Impulse Pressure - Nuclear Power) + (Tavg - Tref)

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

QUESTION 3.04 (3.00)

a. What input signal is used to adjust programmed level for the pressurizer level control system? (0.4)

b. What is the normal programmed pressurizer level at no load and full load? (0.6)

c. If the pressurizer level control channel fails high during 100% power operation, what Reactor Protection signal will cause the Reactor to Trip? Provide a brief explanation of why the Trip occured and the SEQUENCE of events that led to the trip. (Assume no operator action) (2.0)

QUESTION 3.05 (1.50)

While operating at 100% power, the steam pressure compensation signal to the Steam Generator Water Level Control System fails low. What is the immediate response of the feedwater flow? Explain your answer.

QUESTION 3.06 (2.40)

a. State the three Reactor Protection System (RPS) signals and associated logic and coincidences that will close the Feedwater Regulating Valves automatically. (0.8)

b. Which RPS train (A or B) actuates the automatic closure of the Feedwater Regulating Valves? (0.3)

c. True or False

The Manual reset buttoms on MB2 give the operator a means of resetting any Feedwater Isolation Signal while the condition causing the signal still exists. (0.5)

d. How do the Feedwater Regulating Valves and their bypass valves fail upon loss of: (0.8)

1. Pneumatic pressure?
2. Electric power?

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

QUESTION 3.07 (.70)

During an RCS cooldown, INDICATED pressurizer level:

a. is less than actual.

b. is greater than actual. Assume hot Calib. channel

c. is the same as actual.

d. is less than actual at the start of the cooldown but is greater than actual when cooldown is complete.

QUESTION 3.08 (1.20)

Describe the automatic opening and closing functions that are associated with the motor-operated block valves upstream of the Pressurizer PORVs. Logic not required.

QUESTION 3.09 (2.00)

The following concern Pressurizer Pressure controls.

a. State the setpoints and coincidence (ie. 2/3, 2/4, etc.) for the following RPS inputs.

 1. High pressure reactor trip.
 2. Enable manual block of SI.
 3. Low pressure reactor trip.

b. In addition to the RPS trips listed above, state 2 additional RPS inputs from the Pressurizer Pressure detectors.

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

QUESTION 3.10 (3.00)

The following concern RCS instrumentation.

a. Wide Range temperature instruments have a control input to the Cold Overpressure Protection System (COPS). Why are the Narrow Range temperature instruments NOT used in the COPS? (0.5)

b. In addition to the COPS, what other control inputs do the Wide Range temperature instruments supply? (0.4)

c. List seven control inputs provided by the Narrow Range temperature instruments. (2.1)

QUESTION 3.11 (3.00)

The Millstone 3 unit has been operating at 65% with all control systems in automatic. For each of the following conditions, give the direction of initial rod motion and EXPLAIN why the rods move.

a. A Steam Generator PORV fails open. (0.75)

b. A feedwater heater string is bypassed. (0.75)

c. A lower detector of a power range channel fails high (N44). (0.75)

d. "B"(2) RCP trips off. (0.75)

QUESTION 3.12 (1.50)

Describe the opening interlocks associated with MV 8812A&B (RHR suction valves from RWST). What is the purpose of the interlocks?

QUESTION 3.13 (2.50)

a. During a fuel drop accident, how would the radioactivity release be detected? (1.0)

b. What automatic actions occur on detection of high activity as a result of a fuel drop accident? (1.0)

c. What detects radiation that may escape from the containment atmosphere? (0.5)

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

QUESTION 4.01 (3.00)

Answer the following questions regarding EOP 35 FR-H.1, RESPONSE TO LOSS OF SECONDARY HEAT SINK:

a. List the two specific symptoms which warrant entry into this procedure. (2.0)

b. What is required if, during this procedure, the RWST level decreases to less than ~~520,410~~ gallons? (1.0)
520,000

QUESTION 4.02 (2.00)

a. Why is the RHR Pump placed on miniflow recirculation for a minimum of 5 min. prior to placing the train in service for plant cooldown? (0.5)

b. How is a low boron concentration in an RHR train (to be placed in service) corrected? (1.0)

c. Would starting an RHR pump, with the CVCS letdown pressure control valve (PCV-~~145~~) in automatic, result in a pressure INCREASE OR DECREASE in the Reactor Coolant System (RCS) during solid plant operation? 131 (0.5)

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

QUESTION 4.03 (3.50)

a. 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. (1.5)

b. Assume that it is 0310 on 03/18/86 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 calculations). Assume no deviation outside the band after 0310 on 03/18/86.

DATE	TIME WENT OUT OF BAND	TIME BACK IN BAND	POWER
03/17/86	0310	0318	85%
03/17/86	1557	1637	65%
03/18/86	0148	0310	45%

(2.0)

QUESTION 4.04 (2.00)

A leak has developed in a CVCS Letdown piping component located outside the containment building and may be manually isolated. The general area radiation level in the area where the leak is to be isolated is 600 millirem per hour. The one available person to perform the work informs you that his present quarterly exposure and lifetime exposure levels are 2.90 Rem and 54.75 Rem respectively.

a. Using only 10 CFR 20 whole body exposure limits as a guide, how long may this person work in the area before the quarterly exposure limit is exceeded? (SHOW YOUR WORK) (1.5)

b. What is the minimum age that this person may be to perform the work? (SHOW YOUR CALCULATIONS) (0.5)

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

QUESTION 4.05 (2.00)

Assume a peripheral control rod drops into the core at 100% power. According to AOP 3552 "Malfunction of the Rod Drive System".

a. How is Tavg matched with Tref?

b. During recovery why is a Rod Urgent Failure alarm received?

c. Under what circumstances must the AUTO/MANUAL switch at the Pulse/Analog (P/A) Converter be held in MANUAL during rod recovery?

d. Who(m) must be consulted if the rod has been inserted for more than 1 hour?

QUESTION 4.06 (1.00)

State the two entry conditions (symptoms) of high RCS activity as listed in AOP 3553 "High Reactor Coolant System Activity".

QUESTION 4.07 (1.50)

The following pertain to tagging procedures as stated in ACP-QA-2.06A "Station Tagging".

a. Who are the only personnel that are authorized to issue Safety Tags to listed qualified individuals?

b. What is the purpose of a "blue tag" found on a valve?

c. True or False

A tag of no other color may be attached to a switch or device bearing a blue tag.

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

QUESTION 4.08 (2.00)

The following concern ES-0.2 "Natural Circulation Cooldown".

a. Under what conditions is switchover to AFW pump supply to alternate water sources required?

b. While maintaining a cooldown rate of <50 F/hr, what RCS parameter is utilized to monitor the cooldown rate?

c. Describe the method used to lower RCS pressure.

d. While maintaining RCS subcooling >80 F, what RCS temperature indication is utilized to monitor the subcooling?

QUESTION 4.09 (1.00)

What are the Millstone 3 administrative whole body limits according to SHP 4902 "External Radiation Exposure Control and Dosimetery Issue" for the following:

a. With NRC Form 4?

b. With NRC Form 4 and approved exposure upgrade?

QUESTION 4.10 (2.50)

The following concern precaution statements listed in OP 3201 "Plant Heatup".

a. The shutdown banks must be fully withdrawn whenever positive reactivity is being added by Boron or Xenon changes, RCS temperature changes or control bank movement except during 2 conditions. State the two conditions.

b. Why must pressurizer pressure not be allowed to exceed 1985 psia until Steam Generator pressure is >585 psig?

c. Which RCP is the preferred pump for single pump operation?

d. If RCP-A(1) is stopped, why must loop A(1) spray valve be closed?

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

QUESTION 4.11 (2.50)

a. State 4 of the 5 entry conditions for "Immediate Boration" AOP 3566.

b. Under what conditions may Immediate Boration be stopped?

QUESTION 4.12 (2.00)

State the four Immediate Operator Actions listed in ECA 0.0 "Loss of All AC Power". INCLUDE how these actions are verified. NOTE: Sub steps are required.

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

EQUATION SHEET

$F = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$W = v\Delta P$

$\Delta E = 931\ \Delta m$

$\dot{Q} = \dot{m}c_p\Delta T$

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

$Pwr = W_f\Delta h$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

$\Sigma = \sigma N$

$v = s/t$

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

$a = (V_f - V_o)/t$

$\omega = \theta/t$

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

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

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

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

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

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

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

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

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

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

ANSWER 1.01 (1.00)

a. At 200 F density of water is greater; (more lbm/ft3) therefore, it takes more power to move each ft3 of water the same distance. (0.5)

b. m at 200 F is greater than m at 530 F.

Example: m = (v) (p) (3600/1hr)

m/p at 200 F = m/p at 530 F

If p increases m increases.
if p decreases m decreases. (0.5)

REFERENCE
GP HT&FF pp. 288-289, 285

ANSWER 1.02 (3.00)

a. Increase [0.25]. Th will increase while Tc remains relatively constant [0.5].

b. Increase [0.25]. Heat is no longer being removed at the same rate. [0.5].

c. Decrease or no change [0.25] less primary to secondary heat transfer [0.5].

~~d. Decrease [0.25]. Heat sink removed-driving head reduced [0.5].~~

REFERENCE
MP3 GP HTFF p. 357
000056A248
000056A257
000056K101

ANSWER 1.03 (.70)

b.

REFERENCE
MP3 Reactor Theory RT-11 p. 4

ANSWERS -- MILLSTONE 3 -86/04/01-JAGGAR, F.

015000A301

ANSWER 1.04 (3.00)

a. The Fuel Temperature Coefficient becomes less negative as power increases ~~[0.5]~~ 0.75. The resonances associated with Doppler broaden and overlap with increasing fuel temperature. ~~[0.5]~~ 0.75

b. The MTC becomes more negative as power increases because Tave increases. ~~[0.5]~~ 0.75 Since the MTC is principally a function of moderator density change per F, at higher temperatures the change in density per F is greater. ~~[0.5]~~ 0.75

REFERENCE
MP3 Reactor Theory RT-13 p. 4; RT-12 pp. 6-8
00100K549

ANSWER 1.05 (3.00)

a. Increases -------- [0.25] as moderator temperature increases, density decreases allowing neutrons to travel further thus having a higher probability of reaching a control rod [0.5].

b. Increases -------- [0.25] caused by an ~~increase~~ shift in the neutron flux ~~level~~ distribution in the core. [0.5]

c. Decreases -------- [0.25] due to rod shadowing- the other rods absorb the neutrons and reduce flux for the rod in question [0.5]. will also accept - "Anti Shadowing"

d. Central control rods have a higher worth then those on the edges [0.25] because relative flux tapers off at the edges of the core. [0.5]

will accept statement of outer regions (not at edge) of core may be of higher worth than central rods.

REFERENCE
MP3 Reactor Theory RT-14 pp. 2-5
001000K502
001010K504

ANSWER 1.06 (1.50)

a. The slightly (greatly) subcritical reactor will have a larger (smaller) increase in count rate. (0.75)

b. The slightly (greatly) subcritical reactor will take a longer (shorter) time to reach a stable count rate. (0.75)

REFERENCE
MP3 Reactor Theory RT-8 pp. 2-5
015000K506

ANSWER 1.07 (2.00)

After the power decrease, the production of xenon from fission [0.3] and from the decay of iodine [0.4] is greater than the removal by decay of xenon [0.4] and burnout by flux. [0.3] After five hours, the removal rate is greater than the production [0.3] and positive reactivity is being added until equilibrium at about 40 hours. [0.3]

REFERENCE
MP3 Reactor Theory RT-16 pp.4-5
001000K538

ANSWER 1.08 (1.50)

a. 3

b. 2 [0.75 ea.]

REFERENCE
MP3 Reactor Theory RT-10 pp. 3-8
001000K547

ANSWER 1.09 (2.00)

a. 1. As pump speed increases, discharge flow rate increases proportionally. [0.5]

2. As pump discharge head increases, discharge flow decreases (according to the pumps characteristic curve). [0.5]
will also accept discussion of $\dot{v}$, n, and Hp if discussion is complete.

b. 1. Pump runout is the condition when a centrifugal pump is pumping at its maximum capacity. (Greater than the design flow rate). [0.5]

2. When a pump at shutoff head is pumping against a shut discharge valve. (Max head the pump can deliver) [0.5]
will also accept "System pressure above which the pump will not produce flow".

REFERENCE
GP HTFF pp. 320, 322, 328
COMPONENT-PUMPS

ANSWER 1.10 (2.00)

a. Local power density-KW/FT. [0.5] will also accept RCS flow, FQ (z), and Fig 2.1-1 parameters (Power, Tavg, Pressure)

b. DNB (DNBR) [0.5] Also accept kw/ft

c. Clad surface temperature is a function of heat flux and moderator temperature. [0.5] Moderature temperature is higher at the top of the core. [0.5]

REFERENCE
MP3 GP HTFF pp. 224-228, 243-244
002000K510
002020K511

ANSWER 1.11 (1.80)

a. TRUE

b. TRUE

c. TRUE

REFERENCE
MP3 Reactor Theory RT-16, pp. 1-6
001000K533

ANSWER 1.12 (2.00)

a. 1. Ensure the capability to insert adequate negative reactivity such that sufficient shutdown margin exists on a reactor trip.

2. Minimize the amount of positive reactivity an ejected rod can add to the core. Also accept – limit potential effects of rod misalignment on associated accident analysis

3. Ensure acceptable power distribution limits are maintained. (1.0)

b. The rod insertion limits increase as reactor power (dT) increases [0.5].
As power increases, the power defect inserts negative reactivity [0.25]. On a reactor trip, this negative reactivity is removed as power decreases and Tavg decreases to its no-load value [0.25].
Will also accept – ~~[illegible]~~ higher ΔT input to RIL computer [0.5]

REFERENCE
MP3 Topic 6 Lesson 3, pp. 26-27
001000K504

ANSWER 1.13 (1.50)

As the RCS temperature drops, the temperatuare difference across the RHR heat exchanger also drops [0.25]. The cooldown rate will be lower. [0.25]. As a result, the flow through the HX must be increased to maintain the same heat removal rate [0.5]

REFERENCE
GP HTFF P. 178
005000A102

ANSWER 2.01 (1.00)

a. F

b. F

REFERENCE
MP3 Topic 6 Lesson 4 pp.16, 22
015000K407

ANSWER 2.02 (2.00)

a. Normal CCW pump not running
~~Low pump discharge pressure (80 psig)~~
Blackout Sequence
SI Sequence [.75]

b. Phase "B" isolation. [0.5]

c. 2484 psig. +/- 50 psig [.25]
The piping it protects may be subjected to full RCS pressure if a thermal barrier HX leak develops. [.5]

REFERENCE
MP3 Topic 4 Lesson 1 pp. 11, 15, 16
008000K401
008030A304

ANSWER 2.03 (1.50)

a. The Static Transfer Switch automatically transfers to the alternate source of 480 VAC power from Bus (32-2R). [0.5]

b. The DC supply to the inverter is available from the Battery charger and/or battery (301A-1). [0.5]

c. Same as b. [0.5]
Will also accept power is available from alternate source for 1/2 credit.

REFERENCE
MP3 BOP Vol. 1 120 VAC System pp. 10 & 16
062000K410

ANSWER 2.04 (2.00)

a. P1A--34C
   P1B--34D [0.25 each]

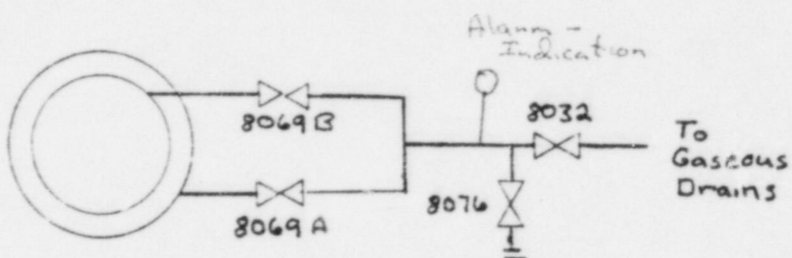
b. Main steam from headers A, B, & D [0.5]

c. P1A & P1B--2/4 [~~0.1~~] 0.2 lo-lo level from 1 S/G [0.2] ~~if stop valves~~
   ~~open [0.1].~~
   --LOSP, SIS, CDA [0.3]
   P2---------2/4 [0.1] lo-lo level on 2/4 S/Gs [0.2]

REFERENCE
MP3 Topic 4 Lession 2 pp. 18, 19, 22, 23
061000K202
061000K414

ANSWER 2.05 (1.50)

Leakage through the O-rings is collected by two leak-off lines. One line penetrates the area between the inner and outer o-ring, the other starts just outside the outer O-ring. Both lines have manually operated valves. Downstream of the isolation valves, the individual lines join to form a common header. The common header can be isolated with an air operated valve.



8069A closed--Outer seal isolation valve
8069B open--Inner seal isolation valve
8032 open----Common Valve to drain
(8076 closed--Blind flange isolation) [0.2 ea.]

REFERENCE
MP3 Topic 1 Lession 1 p. 5
002000K405

ANSWER 2.06 (3.00)

a. As pressure increases, a closing force is exerted on the seal ring. [0.5] The narrowing between the seal faces restricts the flow and increases the pressure felt on the underside of the seal face. [0.5] The increased pressure pushes the seal ring back up, opening the flow passage which allows more flow to escape, [0.5] thus re-establishing a correct equilibrium position.

b. Through #2 seal to the RCDT CDTT [0.5] and the #1 seal return line relief valve to the PRT. [0.5]

c. RCS pressure and the backpressure created by the VCT. [0.5]

REFERENCE
MP3 Topic 1 Lesson 2 pp. 7, 8, 25
Topic 2 Lesson 1 p. 28
002000K602

ANSWER 2.07 (2.00)

	INJECTION	COOLDOWN	CL RECIRC	HL RECIRC
a.	OPEN	CLOSED	CLOSED	CLOSED
~~b.~~	~~CLOSED~~	~~CLOSED~~	~~OPEN~~	~~OPEN~~
c.	CLOSED	OPEN	CLOSED	CLOSED
d.	OPEN	OPEN	~~OPEN~~ CLOSED	CLOSED
e.	CLOSED	CLOSED	CLOSED	OPEN

[~~0.1~~ EACH]
0.125

REFERENCE
MP3 Topic 3 Lesson 4 pp. 62-68
005000K408

ANSWER 2.08 (2.50)

a. Compressor starts--90 psig in receiver ± 5 psig
Compressor stops---110 psig in receiver ± 5 psig [1.0]

b. ~~The Instrument Air System will supply pressure via (31AS-PV15) when Containment Instrument Air pressure drops to 100 psia. [1.0]~~ 0

c True [0.5]

REFERENCE
MP3 Instrument Air System Description pp. 9, 16
078000K401
078000K402

ANSWER 2.09 (1.00)

Valves 8804A & B are opened from the Containment Recirc. Pump discharge to the CCP and SI pump suctions.

REFERENCE
MP3 Topic 3 Lesson 4 pp. 67-68
000074K309
006000K406

ANSWER 2.10 (2.50)

a. ~~5 minutes~~ 660 seconds (11 minutes) [0.5]

b. Allow time for sufficient water to collect in the containment sump. [0.5]

c. MODE I-- all four pumps take suction on the containment sump [0.5] and discharge to spray headers. [0.5]
MODE II-Two pumps lined up to spray headers. [0.25] Two pumps realigned to supply low pressure safety injection. [0.25]

REFERENCE
MP3 Topic 3 Lesson 4 pp. 70-71, 86
006000K102
006000K405

ANSWER 2.11 (2.00)

During normal plant operation, PCV-131 is used to maintain a constant backpressure on the letdown orifices ~~flow control valves~~. (This prevents the letdown flow from flashing to steam in the letdown lines or letdown heat exchanger.) [1.0]

When the plant is solid, water can be diverted from the RHRS to provide letdown upstream of the letdown heat exchanger. PCV-131 can be ~~manually~~ set to maintain desired RCS pressure by controlling RHR pump discharge. [1.0]

REFERENCE
MP3 Topic 2 Lesson 1 pp. 11-12
004010K505
004020K612

ANSWER 2.12 (2.00)

1. Condenses steam ~~[0.5]~~ thereby depressurizes the containment atmosphere. ~~[0.5]~~ [1.0]

2. Removes core decay heat (over the long term by injecting water into the core). [1.0]

REFERENCE
MP3 Topic 3 Lesson 4 p. 69
006050G004

ANSWER 2.13 (2.00)

	RTA	RTB	BYA	BYB
a.	--	TRIP	--	TRIP
b.	TRIP	--	--	TRIP
c.	TRIP	TRIP	TRIP	TRIP

[12 @ 0.17 ea.]

REFERENCE
MP3 Topic 7 Lesson 1, 2, & 3 pp. 20-21
012000A307

ANSWER 3.01 (2.00)

a. 1. DNB
   2. Excessive fuel power (KW/ft) [0.5 ea.]

b. DNB is a function of pressure whereas KW/ft is not related to pressure. [1.0]

REFERENCE
MP3 Topic 7 Lesson 1, 2, & 3 pp. 44-49
012000K402
012000K403

ANSWER 3.02 (1.50)

a. Maintain an even flux distribution or prevent flux peaking. [0.75]

b. (Only one group of rods needs to be reset). The Startup Reset Switch will reset all control rod groups. [0.75]

REFERENCE
MP3 Topic 6 Lesson 2 pp. 42, 25, 11, 46
001010K403
001010K501
000003A102

ANSWER 3.03 (.70)

a.

REFERENCE
MP3 Topic 6 Lesson 2 pp. 19-20
001000K403

ANSWER 3.04 (3.00)

a. Tave (auct high) [0.4]

b. 25.0%, [±.5%] 61.6% [±.5%] [0.6]

c. High pressurizer level trip [0.4] charging flow decreases [0.4] pressurizer level decreases [0.4] letdown isolates [0.4] and pressurizer level increases [0.4]

REFERENCE
MP3 Topic 8 Lesson 4 I & C Failure pp. 61-62
Topic 6 Lesson 6 & 7 p. 25
011000K404
011000K104

ANSWER 3.05 (1.50)

Feedwater flow would decrease [0.5]. The failed compensation signal would cause a decrease in the steam flow signal [0.75] causing a SF/FF mismatch [0.25] causing feed flow to decrease.

REFERENCE
MP3 Topic 6 Lesson 9 p. 18
035010A301

ANSWER 3.06 (2.40)

a. 1. P-14 [0.1] ~~2/3~~ 2/4 [0.1] levels on 1/4 [0.1] Steam Generators.
2. Safety Injection [0.1] 1/1 [0.1]
3. P-4 [0.1] 1/2 [0.1] trip breakers open in coincidence with a low Tavg in 2/4 [0.1] loops.

b. A [0.3]

c. False [0.5]

d. 1. Closed
2. Closed [0.4 each]

REFERENCE
MP3 Topic 6 Lesson 9 pp. 31-32
059000K419
059000A212
059000A411

ANSWER 3.07 (.70)

b.

REFERENCE
MP3 Topic 6 Lessons 6 & 7, p. 23
011000K403

ANSWER 3.08 (1.20)

Open-->2200psig ~~[0.4]~~ 0.6
--(control switch in OPEN) 0.6
--COPS ARM/BLOCK to ARM ~~[0.4]~~

~~Closed--<2200psig [0.4]~~

REFERENCE
MP3 Topic 6 Lesson 6 & 7 p. 17
010000A403

ANSWER 3.09 (2.00)

a. 1. ~~2400~~ 2370 psig 2/4 or 2385 psia
2. 1985 psig 2/3 or 2000 psia
3. ~~1860~~ 1885 psig 2/4 (Setpoint varies as lead-lag circuit) or 1900 psia
[0.2 each]

b. Low pressure Safety Injection
Loop OTdT setpoint circuit [0.4 ea.]
will also accept "PORV Block @ 2200 psia" for full credit.

REFERENCE
MP3 Topic 6 Lesson 6 & 7 pp. 17-18, 6
010000K101

ANSWER 3.10 (3.00)

a. When the COPS is in service, the RCPs are not operating, therefore, the Narrow Range instruments which are located in the bypass manifold would not be reliable. Will also accept narrow range instruments range does not extend to 450 F. [0.5]

b. Loop stop valve logic. [0.4]

c. 1. Rod control
   2. OPdT
   3. OTdT
   4. Steam dump
   5. Feedwater Isolation
   6. Pressurizer level
   7. Rod insertion limits
   8. C-16 input

Any 7 @ [0.3 each]

REFERENCE
MP3 Topic 6 Lesson 8 pp. 5, 19
010000K403

ANSWER 3.11 (3.00)

a. If a S/G PORV opens, the increased steam demand on the S/G will cause Tavg to drop.[0.25] The control rods will move out to match Tavg with Tref. [0.5]

b. The overall feedwater temperature to the S/G will drop. [0.5] Tavg will decrease and rods will move out. [0.25]

c. The N44 signal to the rod control system increases. This indicates a rate of mismatch between reactor power and turbine load. [0.25]. The mismatch circuit will cause rods to drive in. [0.5]

d. All rods will trip in [0.25] because of a single loop loss of flow trip. [0.5]

REFERENCE
MP3 Topic 6 Lesson 2
001000K602

ANSWER 3.12 (1.50)

Valves cannot be opened unless 8804, 8837, 8838A are in the fully closed position. [0.75]

Prevents a potential flow path between the RWST and the Containment Recirc. Pump suction when either RHR or Containment Recirc. system is operating. [0.75]

REFERENCE
MP3 Topic 3 Lesson 4 p. 63
005000K407

ANSWER 3.13 (2.50)

a. Detected by (RE41 & 42) monitors inside containment. [1.0]

b. Closes CTV 32A, B and 33A, B; stops containment purge supply and exhaust fans. [1.0]

c. Detected by the ventilation vent (extended range) monitor RE-10. [0.5]

Additional answers may be accepted if documentation of their validity can be found in facility supplied information.

REFERENCE
MP3 RMS p. 64
034000A401
072000K401
073000K401

Change to read
Rad. element closes damper (32 A/B)
Damper closure stops exhaust fan.
Exhaust fan shut off stops supply unit
[0.75 for actions, 0.25 for sequence]

ANSWERS -- MILLSTONE 3 -86/04/01-JAGGAR, F.

ANSWER 4.01 (3.00)

a. 1) From EOP 35 E-0 "REACTOR TRIP OR SI" when minimum AFW flow is not verified. [1.0]

34%   525

2) S/G NR level < 35% with total FW flow to S/G's < 275 gpm (red path condition). [1.0]

b. ECCS should be aligned for cold leg recirc. [1.0]

REFERENCE
MP3 EOP 35 FR-H.1 pp. 2,9
000054G010

ANSWER 4.02 (2.00)

a. To mix water for sampling. [0.5]
(equalize boron concentration in RCS with RWST)

b. Flowpath aligned from RWST to ~~CVCS letdown (without exceeding 130 gpm thru LTDN HX)~~ until boron concentration is equal to or greater than RCS boron concentration. [1.0]
RHR Pump and back to RWST

c. Decrease [0.5]

REFERENCE
MP3 OP-3310A p. 11
OP-3208 p. 7
005000G012
005000K109

ANSWER 4.03 (3.50)

a. Within 15 (or next 10) minutes [0.5] either
   1. Restore the indicated AFD to within the target band [0.5], or
   2. Reduce the thermal power to <90% of rated thermal power.[0.5]

b. Accumulated penalty over the past 24 hours is 89 minutes.[1.0] The penalty will be reduced to 60 minutes at 1618 minutes on 03/18/85 and then power may be increased.[1.0]

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

03/17/86, from 1557; 81 min left -60 = 21 min -> 1618 03/18/86 [1.0]

REFERENCE
MP3 Technical Specifications 3/4.2.1 p. 1-2
001000A303

ANSWER 4.04 (2.00)

a. 3000 - 2900 mRem = 100 mRem dose remaining [0.5]

600 mR/Hr X 1 Hr/60 minutes = 10 mrem per minute [0.5]

100 mR/10 mR/minute = 10 minutes [0.5]

b. 5(N-18) = 54.75 + 0.10 [0.3]

N - 18 = 54.85/5

N - 18 = 11

N = 11 + 18 = 29 [0.2]

REFERENCE
MP3 SHP 4902 p. 6
9990150000

ANSWERS -- MILLSTONE 3 -86/04/01-JAGGAR, F.

ANSWER 4.05 (2.00)

a. By adjusting turbine load. ~~[0.5]~~ 0.25
or boration as necessary [0.25]

b. An attempt has been made to move a group of rods with all lift coils disconnected. [0.5] will also accept "Urgent Failure due to regulation failure."

c. If the dropped rod is a control rod. [0.5]

d. Reactor Engineer(ing). [0.5]

REFERENCE
MP3 AOP 3552 App. A
001000A203

ANSWER 4.06 (1.00)

1. High activity based on chemistry sample. [0.5]

2. Failed fuel monitor alarm. [0.5]

REFERENCE
MP3 AOP 3553 p. 2
0000076G010

ANSWER 4.07 (1.50)

a. The onshift SS/SCO/SRO. [0.5]

b. The valve is to be operated only by order of the individual to whom the tag is issued. [0.5]

c. True. [0.5]

REFERENCE
MP3 ACP-QA-2.06A pp. 4, 15
9990140000

ANSWER 4.08 (2.00)

a. When DWST level decreases to <80,000 gal. [0.5]

b. RCS Cold leg temperature. [0.5]

c. Letdown (or Pzr PORV) and aux. spray. [0.5]

d. Core exit TCs. [0.5]

REFERENCE
MP3 ES-0.2 pp. 4-6
000074K311

ANSWER 4.09 (1.00)

a. 1000 mr/quarter [0.5]

b. ~~2000 mr/quarter~~ ~~[0.5]~~
2500 mr/qtr [0.25]
and
1500 + 0.5 current quarterly permanent dosimetry reading. [0.25]

REFERENCE
MP3 SHP 4902 p. 9
9990150000

ANSWER 4.10 (2.50)

a. 1. The RCS has been borated to the cold shutdown concentration.
   2. The RCS has been borated to the hot Xenon free concentration and is being maintained at no-load Tavg. [1.0]

b. To prevent inadvertent Safety Injection. [0.5]

c. B(2). [0.5]

d. To prevent "short-cycling" spray flow from the other loop. [0.5]

REFERENCE
MP3 OP-3201 pp. 10, 13, 24, 27
002020G007

ANSWER 4.11 (2.50)

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.

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.

[4 of 5 required, 0.5 each]

b. When the entry condition is satisfied. [0.5]

REFERENCE
MP3 AOP-3566
000024K301
000024K302

ANSWERS -- MILLSTONE 3 -86/04/01-JAGGAR, F.

ANSWER 4.12 (2.00)

1. Verify reactor trip.
   a. Trip and bypass breakers open.
   b. Neutron flux decreasing.
2. Verify turbine trip.
   a. All turbine stop valves clcsed.
3. Check RCS isolated.
   a. Pressurizer PORVs closed.
   b. Letdown isolation valves closed.
   c. Excess letdown isolation valves closed.

~~8~~ 4. Verify AFW flow >525 gpm per intact S/G. [10 at 0.2 ea]

[also accept > 525 gpm Total flow to S/G's]

REFERENCE
MP3 ECA 0.0 pp. 3 & 4
000055K302

MASTER COPY

Attachment 2

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

FACILITY: MILLSTONE 3

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 86/03/25

EXAMINER: HANNON, J.

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	________	________	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
22.00 ~~25.00~~	25.00	________	________	8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
97.00 ~~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 5.01 (1.50)

a. Consider the MP3 reactor operating at constant power and temperature. Will the neutron flux sensed by the excore power range nuclear instruments at EOL be GREATER THAN, SMALLER THAN, or THE SAME AS that sensed at BOL ? Justify your answer. [1.0]

b. What steps are taken to ensure that the excore power range nuclear instruments accurately represent core power throughout core lifetime ? [0.5]

QUESTION 5.02 (1.50)

What is REFLUX BOILING and when would core cooling be provided by this mechanism ?

QUESTION 5.03 (2.00)

a. List three reactor safety concerns if Rod Insertion Limits are violated. [1.5]

b. You commence a start-up with SR counts reading 2×10^3 counts per second. Assuming the SR has not de-energized, you would expect to go critical about the time SR count rate has reached (select one from the following): [0.5]

1. 4×10^3 counts per second
2. 8×10^3 counts per second
3. 16×10^3 counts per second
4. 32×10^3 counts per second

QUESTION 5.04 (1.00)

a. Which condition would result in a higher SUR: a rod ejection accident at BOL or EOL ? Why ? [0.75]

b. The reduction in U-235 alone accounts for the change in Beta Bar with fuel burnup. (TRUE/FALSE) [0.25]

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

QUESTION 5.05 (3.00)

For the following conditions, will the CALCULATED ECP for a startup performed 4 hours after a trip from a 60-day 100 % power run, be HIGHER THAN, LOWER THAN, or the SAME as the ACTUAL control rod position at criticality.

Treat each condition separately. Briefly explain your answers.

1. BOL Rod Worth Curves were incorrectly used to calculate ECP when EOL conditions exist. [1.0]

2. Previous reactor critical data was generated during a 100 % power run which lasted for 2 hours and was preceded by an outage of 12 hours. (Assume previous 60-day 100% power run.) [1.0]

3. One reactor coolant pump is stopped three minutes prior to criticality. [1.0]

QUESTION 5.06 (1.00)

Why is individual RCP flow higher for 3 loop than 4 loop operation?

QUESTION 5.07 (2.50)

a. For BOL conditions, at what MP3 axial core location, TOP, MIDDLE, or BOTTOM, is the critical heat flux at a maximum? [0.25]

Briefly explain why. [0.75]

b. How does the magnitude of the critical heat flux change (INCREASE, DECREASE, STAY THE SAME) as the following parameters are DECREASED. Consider each separately. [1.5]

1. Tavg
2. RCS pressure
3. RCS flow

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

QUESTION 5.08 (3.00)

a. Explain the response of reactor power and Tave during and 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 10E-8 amps and no load Tave. [1.5]

QUESTION 5.09 (3.00)

The plant is operating at 25% power when the #2 steam generator main steam isolation valve fails shut. Given the initial conditions below, indicate the direction (STAYS CONSTANT, INCREASES, DECREASES) of the final steady state values for the listed parameters. Assume no operator actions, all control systems in manual, and no reactor trip or SI occurs.

INITIAL CONDITIONS
Tave = 565 F
Tstm = 550 F
Core delta T = 15 F
Th = 572 F

a. Turbine power [0.25]
b. Tave for affected loop [0.25]
c. Tave for non-affected loops [0.75]
d. S/G pressure for affected loop [0.75]
e. S/G pressure for non-affected loop [0.75]
f. Will S/G code safety valve(s) lift ? [0.25]

QUESTION 5.10 (2.50)

You are operating at 100 % power with RCS Tave at 567 F and a steam pressure of 765 psig. What must Tave be changed to in order to maintain these conditions with 20 % of the tubes in each steam generator plugged ? Show all work, including any applicable formulas.

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

QUESTION 5.11 (2.00)

For the following situations, indicate whether the final stable power level will be HIGHER, LOWER, or THE SAME as the initial power level. Explain your answers. Assume the initial power level is at the point of adding heat following a normal reactor startup at the end of life. Consider each situation separately.

a. Steam dump pressure setting is lowered by 20 psig. [0.5]

b. A small steam leak develops inside containment that is insufficient to initiate SI or CI, but is sufficient to cause an increase in steam flow for the affected steam generator. [0.5]

c. 20 ppm of boron is added, with all systems in manual. [0.5]

d. The steam generator level detector for the SGWLC system fails high. [0.5]

QUESTION 5.12 (2.00)

a. What is the startup rate if a reactor is initally critical and a rod withdrawal results in the intermediate range indications increasing from 2 E -8 amps to 5 E -7 amps in 1 minute and 45 sec? [0.8]

b. Using the following initial conditions, calculate the minimum number of steps of rod bank insertion required to ensure the reactor is subcritical. [1.2]

- SUR is 0.5 DPM
- effective delayed neutron fraction = 0.005
- average neutron precursor decay constant = 0.08 sec -1
- rod bank worth = 5 pcm/step

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

QUESTION 6.01 (1.00)

The design of the RCS is such that the core is more likely to uncover for a cold leg break than for a hot leg break of the same size. Explain why this is true.

QUESTION 6.02 (3.00)

If 6.9 KV Bus 35A is lost while operating at the following power levels, will the reactor trip? Justify your answer by providing the applicable trip setpoint and required logic and coincidence. Consider each case separately and independently.

a. 75% power [1.5]

b. 25% power [1.5]

QUESTION 6.03 (2.00)

The steam pressure detector for # 1 SG sticks at the 100% value when turbine load is decreased from 100% to 75%. Starting with the load decrease, explain the SGWLC System signal processing, including ALL steps of the resulting transient and ending at the final stable conditions.

Assume no operator intervention and all control systems in automatic.

QUESTION 6.04 (2.00)

a. Will a SG Safety Valve(s) lift in a tube rupture event if the affected SG is isolated, SI is actuated and primary pressure levels out at 1200 psig ? Briefly explain your answer. [1.0]

b. In the above case the primary system is being cooled down with the unaffected steam generators and the primary system temperature is at 565 degrees F. The affected steam generator is isolated and its temperature settles out at 570 degrees F. RCPs are secured, SI is terminated, and affected primary loop isolation valves remain open. How would the secondary system interact with the primary system under these conditions? [1.0]

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

QUESTION 6.05 (1.00)

Given the following ECCS pump discharge design flow rates at nominal discharge pressures, ESTIMATE the leak rate if a Loss of Coolant Accident occurred, one train of ~~safety injection~~ ECCS fails to operate, pressurizer level stabilizes on scale, and RCS pressure stabilizes at 1600 psig ? [0.5]
Justify your answer. [0.5]

Containment Recirculation Pump	3950 gpm
Safety Injection Pump	440 gpm
RHR Pump	4000 gpm
Centrifugal Charging Pump	150 gpm

QUESTION 6.06 (2.25)

Refer to the attached Figure 6-1, MAIN ELECTRICAL DISTRIBUTION and indicate the electrical lineup for each of the following conditions by listing in the below matrix the position of each breaker shown (O for OPEN or C for CLOSED).

1. Starting up number three unit (MODE 2)
2. No. 3 Main Generator synchronized (MODE 1)
3. Station blackout (from MODE 1)

PLANT CONDITION ------>>	1.	2.	3.
BREAKER DESIGNATION \\// \/			
15G-3U			
35A-1			
35B-1			
35C-1			
35D-1			
35D-2			
34A-2			
34C-1T-2			
14-U2			
34C-2			
34D-2			
15-U2			
34D-1T-2			
34B-2			

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

QUESTION 6.07 (1.50)

You are operating at 100 % steady state power with containment pressure channel IV (PB 934A) failed high with its associated CTMT PRES Hi-3 alarm annunciator lit. A technician troubleshooting the trip bistables inadvertently de-energizes the instrument power to the input relay bay for containment pressure channel II.

Will a Containment Depressurization Actuation occur? [0.5]
WHY or WHY NOT? [1.0]

QUESTION 6.08 (2.00)

You are operating at 50 % power slowly raising power with rods in automatic. Controlling first stage turbine impulse pressure fails low.

a. What is the initial direction of rod motion ? [0.5]

b. What plant condition is sensed by the instrumentation that will cause the initial rod motion? [1.0]

c. What is the maximum speed of initial rod motion (steps per minute) ? [0.5]

QUESTION 6.09 (2.00)

a. What is the function of the motor-driven auxiliary feedwater pump manual start block signal? [1.0]

b. List one system line up and one switch configuration for which a low-low steam generator water level would not cause an automatic auxiliary feedwater pump start? [1.0]

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

QUESTION 6.10 (2.50)

a. What are two (2) conditions that require the use of the high level waste drain header instead of the preferred low level waste drain header? [1.0]

what's in the sump at any given time (clarification for J. Frouks)

b. The Containment Drain Sump inventory is required to be monitored periodically to verify that the RCS leak rate is within limits. (TRUE/FALSE) [0.5]

c. How can Unidentified RCS Leakage rate be estimated? [1.0]

QUESTION 6.11 (2.00)

a. Describe an IR detector response if the circuitry is overcompensated during a reactor startup. [0.75]

b. Describe an IR detector response if the circuitry is undercompensated during a reactor shutdown, including any effects on SR detector instrumentation. [0.75]

c. What operator action is required to continue a reactor shutdown if one IR channel has failed high ? Include any applicable setpoints. [0.5]

QUESTION 6.12 (3.00)

For the following INITIAL CONDITIONS:

- PRESSURIZER level control selector switch in position I/III;
- PRESSURIZER level in the program band with > 10 % reactor power;
- PRESSURIZER level recorder selected to Channel II,
- and assuming no operator actions;

DESCRIBE the effect on pressurizer level and list two (2) of the indications available to the operator, IF

a. level Channel III fails HIGH. [1.0]

b. Channel II failed HIGH instead of Channel III. [1.0]

c. Channel I fails HIGH instead of II or III. [1.0]

Treat each situation separately.

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

QUESTION 6.13 (.75)

a. Five (5) components are sequentially loaded automatically onto the diesels during a Containment Depressurization Actuation (CDA) with Loss of Off-Site Power that are not loaded automatically during a station blackout with no CDA present. Select these 5 components from the list below and arrange in the proper sequence.

RHR Pump
Aux Feed Pump
CRDM Cooling Fan
Safety Injection Pump
Containment Recirc Pump
Charging pump
Aux Air Recirc Fan
Service Water Pump
RPCCW Pump
Quench Spray Pump

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

QUESTION 7.01 (2.00)

~~a. What two (2) conditions must exist by procedure before a spurious SI actuation can be reset ?~~ ~~[0.8]~~

b. Under what three (3) conditions may an SI be terminated? by procedure? ~~[1.2]~~

QUESTION 7.02 (2.50)

a. Explain how a total loss of AC power can lead to a RCP seal failure. [1.0]

b. List two (2) indications of a failure of a RCP Number 1 seal? [0.5]

c. What are the two (2) reasons for stopping all RCPs in case of a massive RCP seal failure if primary system pressure is less than 1435 psia (1700 psia for ADVERSE CONTAINMENT) ? [1.0]

QUESTION 7.03 (1.00)

a. While attempting a dropped rod recovery on shutdown bank A, the lift coil disconnect switches for all rods in the bank are placed in the ROD DISCONNECTED position. What alarm will initiate when an attempt is made to withdraw the affected rod? [0.5]

b. Choose the one (1) proper action that must take place before re-attempting recovery if the lift coil disconnect switch alignment is corrected one hour and 15 minutes after initial rod drop occurs:

(1) reevaluate Rod Cluster Control Assembly misalignment
(2) consult reactor engineering
(3) verify SHUTDOWN MARGIN
(4) NOTIFY the NRC

[0.5]

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

QUESTION 7.04 (2.00)

a. In the response to inadequate core cooling or degraded core cooling, what two (2) functionally diverse system parameters are checked to verify adequate core cooling has been recovered? [1.0]

b. In the event it becomes necessary to vent the Reactor Vessel in response to potential void formation, under what condition is it necessary to determine the maximum allowable venting time, and why is this necessary? [1.0]

QUESTION 7.05 (3.00)

a. What is the preferred core cooling method during a loss of normal and emergency AC power? Include source of cooling water and heat sink. [1.0]

b. The actions of EOP 35 ECA 0.0 LOSS OF ALL AC POWER require letdown to be isolated. What is the purpose of this action? [0.7]

c. Select the correct sequence of power source attempts when trying to restore power to an AC Emergency Bus:

(1) Emergency Diesel, RSST, NSST

(2) RSST, NSST, Emergency Diesel

(3) NSST, Emergency Diesel, RSST

[0.6]

d. During a recovery from loss of all AC power, why is it necessary to verify that Inverter 6 is energized as soon as power is restored to bus 34C. [0.7]

QUESTION 7.06 (1.00)

The plant startup procedures have recently been modified to require starting a second condensate pump before switching over to the motor driven feed pump from the turbine driven main feed pump. Why was this change necessary?

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

QUESTION 7.07 (2.00)

List the only two (2) actions that can be taken locally at the auxiliary shutdown panel (ASP) to stop an uncontrolled cooldown during a shutdown from outside the control room.

QUESTION 7.08 (3.00)

Answer the following questions concerning the Radiological Protection Program and Fuel Handling Procedures.

a. The Corporate ALARA program includes a total annual exposure guide of __________ mrem gammas and __________ mrem neutrons per year (select best answer from below).

1. 4000, 800
2. 4500, 500
3. 5000, 300
4. 5000, 500

[0.5]

b. Why is it important to orientate a new fuel assembly so that the serial number on the top of the upper nozzle block is in the Southwest corner when storing the new fuel in the storage pool?

[1.0]

c. Assembly and/or evacuation should be considered if personnel will be exposed to radiation dose rates greater than ________ mrem/hr (fill in the blank).

[0.5]

d. Fuel movement in the fuel storage pool area has been suspended because only one criticality-radiation level monitor is operable. What must be done before continuing fuel movement operations? [1.0]

QUESTION 7.09 (1.50)

a. List 2 options the operator has using the primary plant heatup procedure to maintain a given heat-up rate (HUR).

[1.0]

b. What is the maximum primary system heat up rate allowed by procedure?

[0.5]

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

QUESTION 7.10 (2.00)

List four (4) major functions that must be performed by the operator to recover from a SG tube rupture event. [2.0]

QUESTION 7.11 (2.00)

a. List two (2) indications used to verify a reactor trip per E-0. [0.5]

b. SUBCRITICALITY Critical Safety Function Status Tree is RED. Arrange the below list of operator actions required in the Response to Nuclear Power Generation/ATWS procedure in the proper sequence.

1. Initiate immediate boration of RCS
2. Manual Trip Reactor
3. Locally open Reactor Trip & Bypass brkrs
4. Trip Bus 32B and 32N load center supply brkrs

[1.0]

c. Why is it necessary to have two (2) SR neutron flux monitors operable during refueling operations? [0.5]

QUESTION 7.12 (3.00)

a. Define the term ADVERSE CONTAINMENT as used in the EOPs. [1.0]

b. If the following critical safety functions were all ORANGE, which has priority? [1.0]

1. Integrity
2. Heat sink
3. Inventory
4. Containment

c. Briefly explain why loop stop valves are not used to respond to a challenge to a critical safety function. [1.0]

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

QUESTION 8.01 (2.00)

The concentration of the boric acid solution in the Boric Acid Storage System must be verified once a week in accordance with Technical Specification 4.1.2.5. The chemist sampled the boron concentration on the following schedule. (All samples taken at 1200 hours).

Mar 1 --- Mar 8 --- Mar 16 --- Mar 24 --- Mar 31

a. Explain why surveillance time interval requirements WERE or WERE NOT exceeded on Mar 16. [1.0]

b. Explain why surveillance time interval requirements WERE or WERE NOT exceeded on Mar 24. [1.0]

QUESTION 8.02 (1.00)

Which of the following statements is the correct basis for the limits on Axial Flux Deviation (AFD) ?

a. To keep xenon redistribution during slow plant thermal power increases within the envelop of peaking factors which may be reached on subsequent return to lower power level.

b. To keep xenon redistribution during rapid plant thermal power increases within the envelop of peaking factors which may be reached on subsequent return to lower power level.

c. To keep xenon redistribution during slow plant thermal power reduction within the envelop of peaking factors which may be reached on subsequent return to rated power level.

d. To keep xenon redistribution during rapid plant thermal power reduction within the envelop of peaking factors which may be reached on subsequent return to rated power level.

QUESTION 8.03 (1.50)

What is the technical basis for the requirement to reduce Tavg to less than 500 degrees when specific activity limits on the RCS are exceeded?

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

QUESTION 8.04 (2.00)

What are TWO of the THREE means of protection taken to prevent a low temperature over-pressurization accident in MODE 5, in accordance with Technical Specifications?

QUESTION 8.05 (3.00)

Match the lettered technical specifications with the best description (numbered) of their purpose:

a. Limiting Condition for Operation. [1.0]

b. Limiting Safety System Settings. [1.0]

c. Safety Limits. [1.0]

1. As long as automatic protection occurs prior to exceeding this specification, then the abnormal condition will be corrected prior to exceeding any limits.
2. The integrity of the physical barriers which guard against the uncontrolled release of radioactivity is protected as long as this specification is not violated.
3. This specification indicates the lowest functional capability or performance level of equipment required for safe operation of the facility.

QUESTION 8.06 (2.00)

a. How many members are required on the fire brigade per Technical Specifications, Section 6? [0.5]

b. Who may NOT be included as members of the brigade? [1.0]

c. Who is responsible to function as the fire brigade leader? [0.5]

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

QUESTION 8.07 (2.00)

The plant is operating at 75% power and the latest leak rate data shows:

7.2 gpm - Total leakage
3.1 gpm - Leakage due to a leaking charging pump relief valve
1.2 gpm - Leakage into the Primary Drains Transfer Tank
5.3 gpm - Leakage through 3-RHS-MV8701C, RCS Loop 1, HOT LEG to RHR
0.8 gpm - Total primary to secondary leakage
4.2 gpm - Leakage past RCP seals

What limits, if any, have been exceeded?

QUESTION 8.08 (2.50)

Based on TS, should each of the following requests be granted? Justify your decision. Consider each request separately.

a. A request to conduct an approved modification on Power Range Neutron Flux Channel N44, which will require deenergizing the detector. Over Power Delta T Channel II is tripped. Operational Mode 1. [0.5]

b. A request to commence heating up the Reactor Plant from Mode 5 COLD SHUTDOWN with all code pressurizer safety valves inoperable. [0.5]

c. A request to replace the air start solenoid valves on Unit 3 Emergency Diesel Generator number 2, while Unit 3 Emergency Diesel Generator number 1 is OOS. Operational Mode 1. [0.5]

d. An approved work order to replace the seals on both air lock doors, one at a time. Operational Mode 2. [0.5]

e. A maintenance request to simultaneously replace both trains of HEPA filters in the Auxiliary Building ventilation exhaust system on Unit 3. Operational Mode 1. [0.5]

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

QUESTION 8.09 (2.00)

Technical Specification 3.4.4 states "All power-operated relief valves (PORV's) and their associated block valves shall be OPERABLE". For the following situations state what actions are required to be taken within an hour if operations at power are to continue.

a. One or more PORV's inoperable because of excessive seat leakage [1.0]

b. BOTH PORV's inoperable due to sticking valve stems [1.0]

QUESTION 8.10 (3.00)

a. If containment integrity is not met at MP3 in Modes 1 or 2, then what 2 options does the SRO have for corrective action? Time periods are not required. [1.0]

b. In what Mode or Modes is containment integrity NOT required? [0.5]

c. For each of the following situations, indicate YES if containment integrity is preserved and NO if it is violated. If containment integrity is violated, explain what would be necessary to restore it to normal. [1.5]

1) The equipment access hatch is properly closed during refueling operations. Maintenance is repairing a crimped closed penetration pressurization supply line to the door.

2) The outside door of the personnel air lock is properly closed. The inside door is wedged open with a 2x4 to allow for a detailed inspection of the knife (door) seals.

3) The outside containment purge exhaust valve 3HVU-V5 has the operator removed with the valve open.

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

QUESTION 8.11 (1.00)

To go from COLD SHUTDOWN to HOT SHUTDOWN (Operational MODE 5 to MODE 4), what general condition must be satisfied?

QUESTION 8.12 (3.00) Deleted

Classify each of the following occurances using the State of Connecticut Classification Scheme (EPIP FORM 4701-5) provided. Identify what factor(s) were used to determine the final classification.

a. A small plane crashes on the river shore within the plant perimeter about a half mile East of the plant. The radioactive medical isotopes the plane was carrying cannot be located.

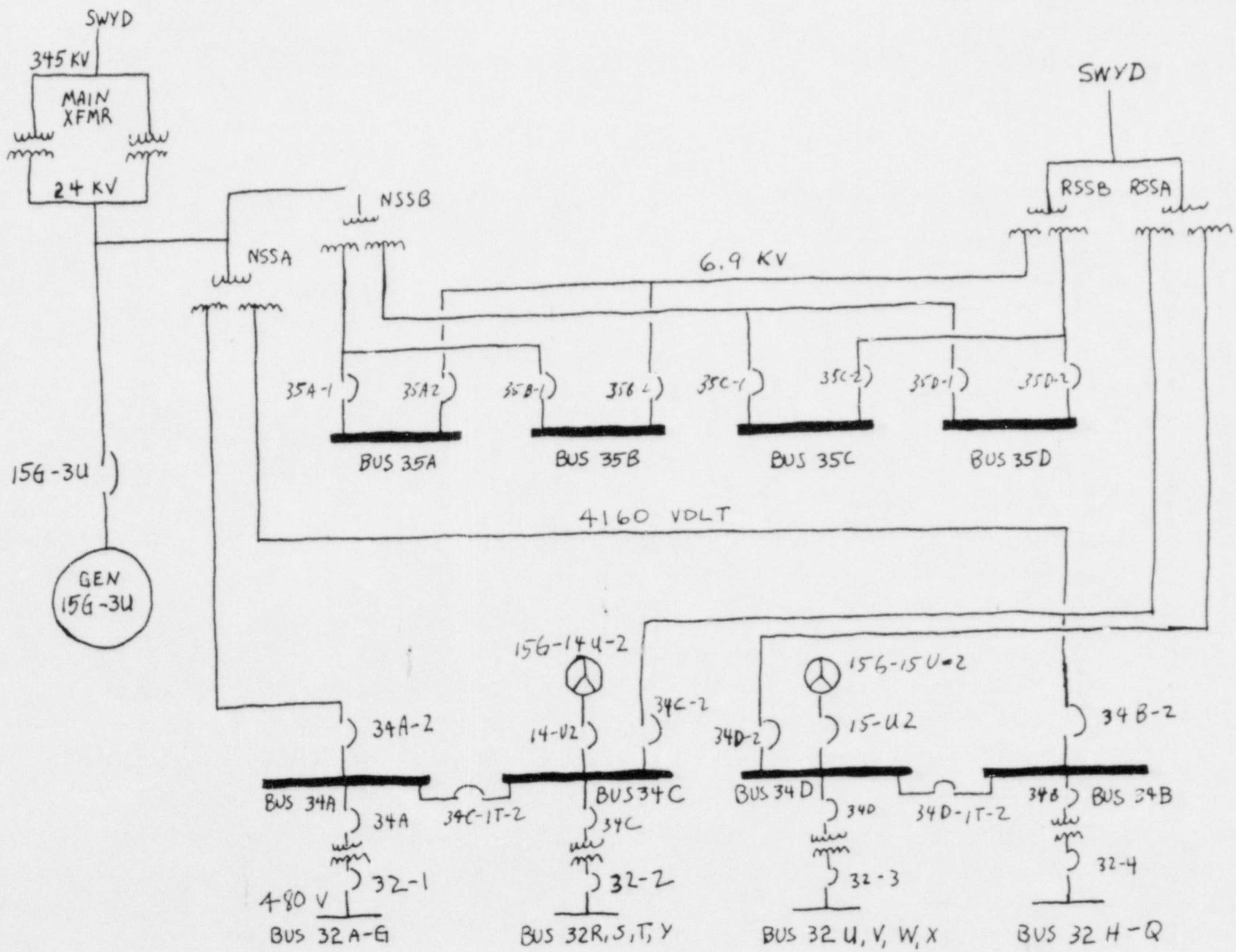
b. While working with the polar crane in the containment during Mode 5, the brake on the hook fails, dropping the hook onto a piping run. The sample line from the pressurizer liquid space ruptures and fuel drop accident area monitor 3RMS-RE41 reading increases to the alarm setpoint of 15 mR/h.

c. An accident in the containment results in an injury to a worker. The worker is in contaminated anti-C clothing and has broken his leg. Due to the accident the worker receives 2 Rem of radiation Previously he had accumulated 500 mrem for the quarter and year.

d. Load following operations at 100% power result in an Iodine spike of 350 uc/gm (> 5 x TS allowable). A main steam line ruptures inside containment. Containment spray is initiated. During the transient five (5) atmospheric relief valves on the affected steam generator lift when the MSIVs shut and two (2) fail to reseat. Reactor to secondary leakage through the affected SG was 500 gpd prior to the event.

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

Figure 6-1. MAIN ELECTRICAL DISTRIBUTION



APPROVAL: EJMroczka DATE: 5-21-84 SORC MTG. NO.: 84-19

STATE OF CONNECTICUT
INCIDENT CLASSIFICATION SCHEME

Incident Class/ Posture Code	Incident Description	Protective Actions/ Emergency Actions
GOLF	Radioactive material transportation accident.	*Limit spread contamination and initiate clean up.
FOX	Lost radioactive material in excess of Title 10, CFR30.71, Schedule B Quantities.	*Assist in source recovery
ECHO	Minor event of general interest but no public hazard with no radioactive releases.	None
DELTA-ONE (unusual event)	Incident with NO unplanned radioactive release.	No protective action required for public.
DELTA-TWO (unusual event)	Incident with no currently existing public hazard but WITH unplanned radiological releases such that site boundary plume doses are less than 0.005 REM to the whole body and/or less than 0.025 REM to the thyroid from plume exposure pathways.	No protective action required for public. Corporate and Station Staff should remain on standby for performance of dose calculations.

Incident Class/ Posture Code	Incident Description	Protective Actions/ Emergency Actions
CHARLIE-ONE (Alert)	Incident which has a potential for projected site boundary plume doses or has a radioactive release with between 0.005 and 0.05 REM to the whole body and between 0.025 and 0.25 REM to the thyroid.	Station and Corporate will activate Emergency Response Facilities. State and local will standby for Key Staff. If appropriate they will actuate Emergency Staff/EOC, and monitor food/water/milk. Bring EBS to Standby Status.
CHARLIE-TWO (Site Area Emergency)	Incident which has a potential for or has a radioactive release with projected site boundary plume doses of 0.05 to 1.0 REM to the whole body and/or 0.25 to 5.0 REM to the thyroid.	Station and Corporate will Activate Emergency Response Facilities. State and local will activate Emergency Staff/ EOC. Monitor food/water/ milk. Consider placing milk animals on stored feed. Alert EBS. Activate EBS and public warning if necessary.
BRAVO (General Emergency Without Containment Breach)	Incident which has a potential for or has radioactive releases with projected site boundary plume doses of 1.0 to 5.0.	Station and Corporate will Activate Emergency Response Facilities. State and local will

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Incident Class/ Posture Code	Incident Description	Protective Actions/ Emergency Actions
	REM to the whole body and/or 5.0 to 25.0 REM to the thyroid.	activate Emergency Staff/EOC. Control food/water/milk. Immediate take shelter/ access control for 2-mile radius and 5-miles downwind. Extend to 10 miles downwind if necessary. Evacuate 2-mile radius if not constrained. Alert EBS. Activate EBS and public warning as appropriate.
ALPHA (General Emergency With Containment Breach)	Incident which has a potential for or has radioactive releases with projected site boundary plume doses of greater than 5.0 REM whole body and/or 25 REM to the thyroid.	Station and Corporate will Activate Emergency Response Facilities. State and local will activate Emergency Staff/ EOC. Control food/water/ milk. Immediate take shelter/access control for 2-mile radius and 10 miles downwind. Evacuate 2-mile radius and 5 miles downwind if not constraine Assess need for additional evacuation. Alert EBS. Activate EBS and Public warning as appropriate.

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Equations

$Q = M\Delta h$

$\dot{Q} = \dot{m}c_p\Delta T$

$Q = UA\Delta t$

$h_L = K\dot{V}^2$

$\pi = 3.14$

$e = 2.72$

$SUR = 26 \dfrac{(\lambda \rho + \dot{\rho})}{\bar{\beta}_{eff} - \rho}$

$\tau = \dfrac{\ell^*}{\rho} + \dfrac{\beta - \rho}{\rho \bar{\lambda}}$

$\rho = \dfrac{1}{\tau K_{eff}} + \dfrac{\beta}{1 + \lambda\tau}$

$SUR = \dfrac{26\ \rho}{\ell^* + (\beta - \rho)\ \tau}$

$C_1(1-K_1) = C_2\ (1-K_2)$

$P = Po\ 10^{\ sur\ (t)}$

$P = Po\ e^{t/\tau}$

$SUR = \dfrac{26.06}{\tau}$

$\tau = \dfrac{\rho}{\rho - \beta}$

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

$CR = \dfrac{S}{1-K_{eff}}$

$\dfrac{1}{M} = \dfrac{CR_1}{CR_2}$

$\ell^* = 10^{-5}$ seconds

Conversions

1 curie = 3.7×10^{10} dps

1 gal = 3.78 liters

1 in = 2.54 cm

1 yr = 2.15×10^7 sec.

1 MW = 3.41×10^6 BTU/HR

1 kg = 2.2lbs

1 gm/cm³ = 62.4 lbs/ft³

1 ft³ = 7.48 gal

1 gal. = 8.3453 lbm.

ANSWERS -- MILLSTONE 3 -86/03/25-HANNON, J.

ANSWER 5.01 (1.50)

a. GREATER THAN. [0.25]
As fuel burns up, flux must increase to maintain the same power level. [0.75]
b. Periodic calibration, ~~and~~ gain adjusts, and ~~are performed,~~ calorimetrics are performed. ~~at various power levels.~~ [0.5]

REFERENCE
MP3 System Description Topic 6 Lesson 4 Excore Nuclear Instrumentation
MP3 Reactor Theory RT-3.6

ANSWER 5.02 (1.50)

Reflux boiling occurs when steam exits the core and is condensed in the SG tubes, with the resulting condensate returning to the core via the hot leg to repeat the cycle. [1.0]

This type of cooling occurs with a voided core when no reactor coolant pumps are running. [0.5]

REFERENCE
MP3 Mitigating Core Damage - Loss of Coolant Accident and Post Accident Cooling, page 1.12, 1.31
MP3 Heat Transfer Thermodynamics and Fluid Flow Fundamentals Section III Part B, Chapter 3

ANSWER 5.03 (2.00)

a. (1) Acceptable nuclear peaking factors. [0.5]
(2) Adequate shutdown margin. [0.5]
(3) Bound rod ejection accident analysis assumptions. [0.5]

b. (4) [0.5]
(The rule of thumb is 4 or 5 doublings of the original count rate).

REFERENCE
MP3 TS, B 3/4 1-3;
MP3 Reactor Theory and Operating Characteristics, Topic: Subcritical multiplication, page RT-8.8.

ANSWER 5.04 (1.00)

a. EOL [0.25]
Because a lower Beta Bar at EOL results in a ~~greater~~ HIGHER SUR ~~peak power level.~~ at EOL. [0.5]
b. FALSE [0.25]

REFERENCE
MP3 Reactor Theory and Operating Characteristics, Topic: Prompt and Delayed Neutron Fractions, page RT-9.4.

ANSWER 5.05 (3.00)

1. ~~LOWER~~ HIGHER Rod worth increases over core life. More rod withdrawal would be necessary to assume the same reactivity addition [0.5]
~~The core is less sensitive to reactivity insertions at BOL due to a larger beta bar;~~ actual criticality at EOL would occur sooner than predicted, if BOL conditions were assumed. Thus, [0.5]
2. ~~LOWER~~ HIGHER [0.5]
Previous RCD accounts for more xenon poison than exists in the actual startup; thus the ECP will indicate more rod motion than is necessary to achieve criticality. [0.5]
3. SAME [0.5]
Insignificant temperature change. [0.5]

REFERENCE
MP3 Reactor Theory Section, 15, 16, and 17

ANSWER 5.06 (1.00)

Head losses are less in the 3 loop configuration. [1.0]

REFERENCE
MP3 Heat Transfer Thermodynamics and Fluid Flow Section III Part B, Chapter 1, page 326

ANSWER 5.07 (2.50)

a. BOTTOM of the core. [0.25]
The critical heat flux is inversely related to reactor coolant quality, which is essentially nil at the bottom of the core (before any steam bubbles have started to form on the heat transfer surface). [0.75]

b. 1. INCREASE
2. DECREASE
3. DECREASE [0.5 each] [1.5]

REFERENCE
MP3 Heat Transfer Thermodynamics and Fluid Flow Fundamentals Figure 4-9 page 229.

ANSWER 5.08 (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 level. [0.5] [1.5]

b. Tave does not change due to the boration. [0.5] (Tave is determined by the amount of pump heat and the steam dump setting.) After the initial transient, power decreases at a negative 1/3 DPM rate to the multiplied source level. [1.0] [1.5]

REFERENCE
MP3 Transient and Accident Analysis Chapter 4.10

ANSWERS -- MILLSTONE 3 -86/03/25-HANNON, J.

ANSWER 5.09 (3.00)

a. Turbine power - STAYS CONSTANT at 25 % power [0.25]
b. Tavg (affected loop) - INCREASES (final value equal to Th) [0.25]
c. Tave (non-affected loops) - DECREASES [0.75]
d. S/G pressure (affected loop) - INCREASES [0.75]
e. S/G pressure (non-affected loops) - DECREASES [0.75]
f. Yes (in affected loop when pressure exceeds 1185 psig). [0.25]

REFERENCE
Steam Tables
MP3 System Description, Topic 1, Lesson 3, page 17
Transient & Accident Analysis, Chapter 4, Page 4.11

ANSWER 5.10 (2.50)

S/G heat transfer = Q = UA(Tavg - Tstm) [1.0]

Q, U, and Tstm remain constant;

A1(Tavg1 - Tstm) = A2(Tavg2 - Tstm)

Given: A2 = 0.8 x A1

From Steam Tables: Tsat for 780 psia = 515 F [1.0]

A1(567 - 515) = 0.8A1(Tavg2 - 515)

Tavg2 = 580 F (13 degree increase) [0.5]

REFERENCE
MP3 Heat Transfer Thermodynamics and Fluid Flow Fundamentals
Section II, Part B, Chapter 2

ANSWER 5.11 (2.00)

a. HIGHER [0.25] steam dump pressure setting decrease causes RCS temperature to decrease. MTC and FTC both add positive reactivity to increase power. [0.25] [0.5]

b. THE SAME [0.25] the steam dump system will compensate for steam leak by shutting valves to maintain demanded steam generator pressure. [0.25] [0.5]

c. THE SAME [0.25] the negative reactivity will be matched by the positive reactivity added by MTC and FTC, causing no change in power. [0.25] [0.5]

d. LOWER ~~HIGHER~~ [0.25] Bypass FRV will close until flow error offsets level error. ~~RCS temperature will decrease due to additional feedwater being added to the steam generator adding positive reactivity causing power to increase~~. [0.25] [0.5]
Rx trip will occur when actual level decreases (to 30% on 2/4 detectors in 1/4 SG).

REFERENCE
MP3 Transient and Accident Analysis Section 3 Normal Transient Analysis
MP3 NSSS Topic 6 Lesson 9 SGWLCS

ANSWERS -- MILLSTONE 3 -86/03/25-HANNON, J.

ANSWER 5.12 (2.00)

a. $P = Po(10)^{sur(t)}$ where t given in minutes [0.4]

$5 \times 10^{-7} / 2 \times 10^{-8} = (10)^{(1.75)sur}$ [0.2]

log(25)/1.75 = sur = .8 DPM [0.2]

b. compute the reactivity represented by the stable SUR:

rho = beta eff/ 1 + lambda bar(26.06/sur) [0.5]

= 0.005/ 1 + 0.08 (26.06 / 0.5) [0.4]

= 96.7 pcm [0.1]

Steps = 96.7 pcm/ 5 pcm/step
= 19 steps (± 1 step) [0.2]

REFERENCE
MP3 Transient and Accident Analysis Section 3 Normal Transient Analysis
MP3 Reactor Theory RT-10.3
MP3 Topic 6 Lesson 4 Excore Nuclear Instrumentation

ANSWER 6.01 (1.00)

Steam venting out the break occurs sooner [0.25] for a hot leg break than for a cold leg break because of the loop seal between the S/G and RCP [0.25]. Thus, injection flow is more effective in the hot leg break because injection flow exceeds break flow when break flow shifts from 2-phase to all steam [0.25]. Therefore, less mass is lost from the system [0.25]. [1.0]

REFERENCE
Mitigating Core Damage LOSS OF COOLANT ACCIDENT AND POSTACCIDENT COOLING page 1.32

ANSWER 6.02 (3.00)

a. YES. [0.50] The reactor will trip if 2 out of 3 circuits [0.25] in any 1 out of 4 loops [0.25] sense < 90% flow [0.25] with power > 39% [0.25] (P-8). [1.5]

b. NO. [0.5] The reactor will not trip because the required logic is 2 out of 3 circuits [0.25] sensing < 90% flow [0.25] in 2 out of 4 loops [0.25] with power between 10% (P-7) and 39% [0.25] (P-8). [1.5]

REFERENCE
MP3 Simulator Malfunction Cause & Effects Document - ED03
MP3 NSSS Topic 7 RPSAS pages 54 and 66

ANSWER 6.03 (2.00)

As power decreases, steam flow detector delta-P decreases, and steam generator pressure increases. [0.4]
Since steam flow uses a square root extractor corrected for steam pressure, and steam pressure is stuck at a lower value than actual, indicated steam flow will be lower than actual flow. [0.4]
The steam-feed flow error signal will tend to close the FWRV. [0.4]
As the level decreases, the level signal will open the FWRV. [0.4]
Eventually, the level error will cancel the flow error and steam flow will equal feed flow at a lower level. [0.4] [2.0]

REFERENCE
MP3 NSSS Topic 6 I&C Systems Lesson 9 Steam Generator Water Level Control

ANSWER 6.04 (2.00)

a. Yes. [0.25]
With MSIV shut, affected SG will equalize with primary pressure. First valve set at 1185 psig. [0.75]

b. SG would backfeed primary due to Psat being higher than primary (Psat for 570 F = approximately 1230 psia). [1.0]

REFERENCE
MP3 Transient and Accident Analysis Section 10
Steam Generator Tube Rupture

ANSWER 6.05 (1.00)

Estimated leakage would be the ~~sum of~~ flow rate from one centrifugal charging pump (.25) ~~and one safety injection pump [0.5] discharge flow rates:~~
~~590~~ 400 gpm (~~+150 -50~~ ±50 gpm) [0.75] [1.0]

[Estimate is made assuming 150 gpm at 2250 # (given) and runout occurs at 550 gpm at 660 #.]

REFERENCE
MP3 NSSS Topic 3 Lesson 4 ECCS

ANSWER 6.06 (2.25)
Assuming NSST is available:

PLANT CONDITION ------>> BREAKER DESIGNATION	1.	2.	3.
15G-3U	O	C	O
35A-1	C	C	O
~~35B-1~~	~~C~~	~~C~~	~~O~~
35B-2	O	O	O
35C-1	C	C	O
35D-1	C	C	O
35D-2	O	O	O
34A-2	C	C	O
34C-1T-2	C	C	C
14-U2	O	O	C
34C-2	O	O	O
34D-2	O	O	O
15-U2	O	O	C
34D-1T-2	C	C	C
34B-2	C	C	O

[2.25]

REFERENCE
MP3 BOP Introduction to Electrical Systems
MP3 main One Line/Phasing Diagram Power Distribution System
Composite S & W DWG NO. 12179-EE-1A-6
MP3 BOP Electrical Distribution System 4160 Volt System

ANSWER 6.07 (1.50)

NO. [0.5]
The input relay must energize to actuate for an unsafe condition (to avoid inadvertent spray actuation in the event of a loss of instrument power). [1.0]

REFERENCE
MP3 NSSS Topic 7 RPSAS p 16

ANSWER 6.08 (2.00)

a. Rods drive in. [0.5]
b. Sudden reactor/turbine mismatch. [1.0]
c. 72 steps per minute [0.5]

REFERENCE
MP3 System Description Volume 4 Rod Control

ANSWER 6.09 (2.00)

a. Prevent starting the motor-driven auxiliary feedwater pumps from the main control board while the emergency generator load sequencer is operating. [1.0]

b. SWITCH CONFIGURATIONS:
(1) The TRANSFER switch in LOCAL and the STOP-AUTO-START switch on the switchgear bus in STOP
(2) The TRANSFER switch in REMOTE and the STOP-AUTO-START switch on the control board in STOP
(3) The TRANSFER switch in REMOTE and the STOP-AUTO-START switch on the control board in PULL-TO-LOCK
(4) Sequencer test lineup [any one 0.5]
SYSTEM LINE UP:
(1) The affected steam generator RCS loop is isolated
(2) AFW Pump Suction Valves closed ~~[0.5]~~ [any one 0.5] [1.0]

REFERENCE
MP3 NSSS Topic 4 Lesson 2 Auxiliary Feedwater System

ANSWER 6.10 (2.50)

a. High radiation [0.5]
Toxic chemicals [0.5]
[1.0]

b. TRUE [0.5]

c. Charging/Letdown flow balance
Monitor sump level and pump operation.
RCS inventory computer program [any one] [1.0]

REFERENCE
MP3 BOP Reactor Plant Aerated Drains
MP3 P & ID Radioactive Liquid Waste & Aerated Drains Sh 3 of 3
TS 4.4.6.2.1
AOP 3555 Reactor Coolant Leak

ANSWER 6.11 (2.00)

a. Overcompensation results in a lower than actual reading [0.25] with indicated level increasing at a higher than actual rate, ~~[0.25]~~ giving a false high startup rate indication. ~~[0.25]~~ [0.50] [0.75]

b. Undercompensation results in a higher than actual reading, [0.25] and if > 5 x 10E-11 amps [0.25] will prevent the SR detectors from automatically energizing [0.25]. [0.75]

c. The operator can manually energize the SR detectors with the SR Block-Reset switch [0.25] when the operable IR channel drops below 5 x 10E-10 amps (P-6 setpoint) [0.25]. [0.5]

REFERENCE
MP3 Transient and Accident Analysis, Instrumentation and Control Failure Analysis pages 5.32 - 33
MP3 NSSS Topic 6 Lesson 4 Excore NI page 18, 19

ANSWER 6.12 (3.00)

a. Steady state operation. [0.5] High Level alarm and Channel III level indicating HIGH. [0.5] [1.0]

b. Steady state operation. [0.5] High Level alarm, Channel II level indicating HIGH, and the recorder indicating HIGH (any two). [0.5] [1.0]

c. FINAL RESULT:
Actual level increases until high level trip (2/3)
(Logic not required) [0.5]

INDICATIONS:
High level deviation alarm
Back up heaters turn on
High error signal reduces charging flow to minimum
Actual pressurizer level decreases (initially)
Low level alarm
Letdown secures and all heaters turn off
(any two of above indications) [0.5] [1.0]

REFERENCE
MP3 Transient and Accident Analysis Section 5, page 5.52

ANSWER 6.13 (.75)

a. Charging Pump
Quench Spray Pump
Safety Injection Pump
RHR Pump
~~Aux Air Recirc Fan~~
Containment Recirc Pump
(0.1 each + 0.25 for proper sequence) [0.75]

REFERENCE
MP3 BOP Introduction to Electrical Systems
MP3 Main One Line/Phasing Diagram Power Distribution System
Composite S & W DWG NO. 12179-EE-1A-6

ANSWERS -- MILLSTONE 3 -86/03/25-HANNON, J.

ANSWER 7.01 (2.00)

~~a. P-4 Permissive; reactor is tripped [0.4] and all ECCS loads are started [0.4] (after a preset time delay).~~ ~~[0.8]~~

~~b.~~ 1. Adequate RCS subcooling ~~[0.4]~~ 0.6
2. Secondary heat sink ok ~~[0.4]~~ 0.6
3. RCS inventory ok (PZR L/Press) ~~[0.4]~~ 0.8 ~~[1.2]~~

REFERENCE [2.0]
MP3 NSSS Topic 7 RPSAS
Westinghouse Owners Group Emergency Response Guidelines
Executive Volume - Generic Issues

ANSWER 7.02 (2.50)

a. (1) Loss of high pressure injection flow from CVCS;
(2) Loss of cooling water flow to the RCP thermal barrier cooling system heat exchangers;
(3) Continuous loss of RCS coolant occurs;
(4) Seal overheating results in degredation and eventual failure. [0.25 EACH] [1.0]

b. (1) RCP HI RANGE LKG FLOW HI alarm;
(2) RCP LO RANGE LKG FLOW LOW alarm (followed by above alarm);
(3) An unexplained increase in the RCP Seal Water Return
~~(4)~~ Flow above 5 gpm with a corresponding RCP Lower Bearing water temperature approaching 230 degrees F.
(ANY TWO) [0.25 each] [0.5]

c. Minimize mass transfer out the break; [0.5]
Lessen the possibility of forming two phase flow in RCS with resulting poor heat transfer properties and potential for inadequate core cooling. [0.5] [1.0]

REFERENCE
MP3 Mitigating Core Damage; Loss of All AC Power, page 4.3
EOP 35 E-1 Loss of Reactor or Secondary Coolant
MP3 NSSS Topic 1 Lesson 2 Reactor Coolant Pump
AOP 3554 RCP TRIP or SEAL FAILURE

(4) #2 RCP Seal leakoff flow high alarm
(5) An increase in the affected pump seal water supply flow
(6) An increase in the Leakoff Flow Recorder (s)
(7) A decrease in PZR level with PZR Level Deviation Alarm
(8) An increase in charging flow

ANSWER 7.03 (1.00)

a. ROD CONTROL URGENT FAILURE [0.5]
b. (2) [0.5]

REFERENCE
AOP 3552 MALFUNCTION OF THE ROD DRIVE SYSTEM, DROPPED ROD
Technical Specification 3.1.3.1
MP3 NSSS Topic 6 Lesson 2 Rod Control

ANSWER 7.04 (2.00)

a. (1) RVLMS plenum level ~~[0.5]~~ (GREATER THAN OR EQUAL TO 19%)

AND

(2) (at least two) RCS hot leg temperatures ~~[0.5]~~ (LESS THAN 350 degrees F) OR
(3) CORE Exit TCs [1.0]

b. IF PRT not available, or PRT rupture disc fails while venting the Reactor Vessel to the PRT (either one) [0.5]

maintain Containment Hydrogen concentration LESS THAN 3% [0.5] [1.0]

REFERENCE
EOP 35 FR-C.1 RESPONSE TO INADEQUATE CORE COOLING
EOP 35 FR-C.2 RESPONSE TO DEGRADED CORE COOLING
EOP 35 FR-I.3 RESPONSE TO VOIDS IN REACTOR VESSEL
Mitigating Core Damage LOSS OF COOLANT ACCIDENT AND POSTACCIDENT COOLING

ANSWERS -- MILLSTONE 3 -86/03/25-HANNON, J.

SAFETIES (if no operator action) or

ANSWER 7.05 (3.00)

a. The steam driven AFW pump provides feed [0.5] and the secondary PORVs (if air restored) dump steam to atmosphere [0.25] to promote natural circulation (0.25). [1.0]

b. Minimize RCS inventory loss (and shrinkage due to cooldown). [0.7]

c. (1) [0.6]

d. Restore power to the plant process computer. [0.7]

REFERENCE
EOP 35 ECA 0.0 LOSS OF ALL AC POWER
OP 3345A 120 Volt Non-Vital Instrument AC
MITIGATING CORE DAMAGE CHAPTER 4 P 4.8 - 4.12

ANSWER 7.06 (1.00)

To avoid unplanned reactor trips due to low-low SG level (caused by loss of main feedwater pump suction). [1.0]

REFERENCE
Report of unplanned reactor trip at 1042 hours on February 12, 1986; the 4th such trip at MP3 since initial criticality.
OP 3321 Feedwater

ANSWER 7.07 (2.00)

a. close SG atmospheric dumps ~~[1.0]~~

b. close atmospheric dump bypass valves ~~[1.0]~~

c. throttle AFW flow (ANY TWO) [2.0]

REFERENCE
EOP 3503 SHUTDOWN OUTSIDE CONTROL ROOM

ANSWERS -- MILLSTONE 3 -86/03/25-HANNON, J.

ANSWER 7.08 (3.00)

a. 4 [0.5]

b. This orientation must be maintained to ensure proper positioning of the fuel in the core and ease of SNM accountability. [1.0]

c. 10 [0.5]

d. Restore the inoperable instrument to service, or Provide an appropriate portable continuous monitor with the required alarm setpoint. (either one) [1.0]

REFERENCE
SHP 4902 Rev. 8 External Radiation Exposure Control and Dosimetry Issue page 10
EPIP 4010A Shift Supervisor
EPIP 4001 Director of Station Emergency Operations
OP 3211A New Fuel Assembly Receipt and Inspection p 22
OP 3210B
TS Table 3.3-6 Action 28

ANSWER 7.09 (1.50)

a. 1. Start/stop RCPs
2. PZR B/U heaters ON/OFF
3. RHR flow control
(any two) [1.0]

b. 100 degrees F in any one hour period [0.5]

(Half credit for 60°F/hr because it is provided by T.S. 3.4-2 referenced by Precaution 4.3)

REFERENCE
OP 3201 page 17
Technical Specification 3.4.9.1

ANSWER 7.10 (2.00)

1. Diagnose and identify faulted SG
2. Isolate affected SG
3. Cooldown primary system
4. Depressurize primary system
5. Terminate SI
   (any 4) [2.0]

REFERENCE
MP3 Transient and Accident Analysis
STEAM GENERATOR TUBE RUPTURE
EOP 35 E-0
AOP 3556 STEAM GENERATOR TUBE LEAK
EOP 35 E-3 STEAM GENERATOR TUBE RUPTURE

ANSWER 7.11 (2.00)

a. 1. Digital RPI at ZERO
   2. Reactor trip and bypass breakers OPEN
   3. DECREASING neutron flux on NIs
   (any two: 0.25 each) [0.5]

b. 2,4,1,3 [1.0]

c. Redundant subcriticality monitoring capability (as required by TS). [0.5]

REFERENCE
MP3 Mitigating Core Damage, Anticipated Transients Without Trip
EOP 35 E-0 Reactor Trip or Safety Injection
EOP 35 FR-S.1
TS Bases 3/4.9.2

ANSWER 7.12 (3.00)

a. High temperature and/or radiation levels that affect instrument accuracy. [1.0]

b. 2 [1.0]

c. Loop stop valves were not designed to be used for accident mitigation purposes. (OP 3205 allows shifting from 4 loop to 3 loop configuration in a controlled manner for normal plant operation with one loop out of service.) [1.0]

REFERENCE

Westinghouse Emergency Response Guidelines, Executive Volume

ANSWER 8.01 (2.00)

a. Interval requirement not exceeded [0.5]. Eight days does not exceed 1.25 times the specified interval [0.5]. [1.0]

b. Interval requirement exceeded [0.5]. The last 3 consecutive intervals exceed 3.25 times the specified interval [0.5]. [1.0]

REFERENCE
TS 4.0.2
MP3 Topic 2 CVCS Lesson 2 Reactor Makeup System

ANSWER 8.02 (1.00)

d [1.0]

REFERENCE
TS B 3/4 2-2

ANSWER 8.03 (1.50)

Prevents a release of activity in event of a SGTR [1.0] because the saturation pressure for 500 degrees is less than atmospheric steam relief valve setpoint [0.5]. [1.5]

REFERENCE
TS B 3/4 4-7

ANSWER 8.04 (2.00)

1. Two PORV's operable with appropriate relief setpoints
2. Two RHR suction relief valves (each with a setpoint of 450 PSIG)
3. RCS depressurized (with vent area at least 7 square inches)

[TWO required; 1.0 each] [2.0]

REFERENCE
TS RCS Overpressure Protection Systems 3.4.9.3

ANSWER 8.05 (3.00)

a-3 [1.0]
b-1 [1.0]
c-2 [1.0]

REFERENCE
10CFR50.36
MP3 TS

ANSWER 8.06 (2.00)

a. 5 [0.5]

b. Brigade shall NOT include the minimum shift crew required for safe shutdown of Unit 3 [0.5] and any personnel required for essential functions during the fire. [0.5] [1.0]

c. One of the brigade members is designated as the leader. [0.5]

REFERENCE
EOP 3509 Rev 3 Attachment C
OP 3256

ANSWER 8.07 (2.00)

RCS Pressure Isolation Valve Limits exceeded. [1.0]

UNIDENTIFIED Leakage limits exceeded. [1.0]

REFERENCE
MP3 P&ID LOW PRESSURE SAFETY INJECTION SH 1 of 3
Technical Specification 3.4.6.2

ANSWER 8.08 (2.50)

a. Yes[0.2] no bistable for OPdeltaT from NI's. [0.3]
Also accept Yes. Provided 200°F was not exceeded. [0.5]
b. No [0.2] cannot enter Mode 4 unless applicable LCO's are met. [0.3] [0.5]
c. No [0.2] do not intentionally enter action statement for maintenace unless other DG demonstrated OPERABLE. [0.3] [0.5]
d. Yes [0.25] maintenance and entry into action statement has been approved ~~by lead Department Head.~~ [0.25] [0.5]
e. No [0.2] only if one train at a time is taken out of service. [0.3] [0.5]

REFERENCE
Functional Diagram Primary Coolant System Trip Signals sheet 5
T.S. 3.04, 3.7.9, 3.6.1.3
ACP-QA-2.02C

ANSWER 8.09 (2.00)

a. Either restore the PORV(s) to operable status [0.5] or close the associated block valve(s) [0.5] [1.0]

b. Either restore the valves to operable status [0.5] or close the block valves AND remove power from the block valves [0.5] (AND be in HOT STBY within the next 6 hours and in HOT SHUTDOWN within the next 6 hours). [1.0]

REFERENCE
TS 3.4.4

ANSWER 8.10 (3.00)

a. Restore containment integrity (1 hr) [0.5] OR
Go to cold shutdown (within the next 36 hours) [0.5] [1.0]

b. Mode 5 COLD SHUTDOWN Mode 6, also accepted. ~~Since~~ if included with Mode 5 as an answer. (with no core alterations or fuel movement) [0.5]

c.
1) YES [0.5]
2) YES [0.5]
3) No. The valve must be closed. [0.5]

REFERENCE
T. S. Definitions and 3.6.1.1

ANSWER 8.11 (1.00)

The full complement of equipment for MODE 4 must be operable, or another way of saying this, LCO's for MODE 4 must be met without reliance on the Action Statements. [1.0]

REFERENCE
TS B 3/4 0-1

Also accept fox.

Deleted

ANSWER 8.12 (3.00)

a. GOLF [0.5] does not effect plant ops, was not initiated by plant, and does not effect local travel patterns. [0.25] (Convert to FOX if source recovered). [0.75]

b. DELTA-TWO [0.5] due to leak rate [0.25] [0.75]

c. DELTA-ONE [0.5] due to transport of contaminated individual. [0.25] [0.75]

d. CHARLIE-TWO (or higher) [0.5] Pri-Sec leak rate combined with IODINE Spike [0.25] [0.75]

REFERENCE
EPIP 4701
MP3 BOP Radiation Monitoring Systems

$f = ma$

$v = s/t$

Cycle efficiency = (Network out)/(Energy in)

$w = mg$

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

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$

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

$PE = mgh$

$V_f = V_o + at$

$w = \theta/t$

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

$W = v\ \Delta P$

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

$\Delta E = 931\ \Delta m$

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

$\dot{Q} = \dot{m}Cp\Delta t$

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

$Pwr = W_f \Delta h$

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

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

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

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

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

$\ell^* = 10^{-5}$ seconds

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

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

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

$\Sigma = \sigma N$

$I_1 d_1 = I_2 d_2$

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

$R/hr = (0.5\ CE)/d^2$ (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 $lbf/in.^2$

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

Attachment 3

COMMENTS ON NRC WRITTEN EXAMS AND ANSWER KEYS

REACTOR OPERATOR EXAM

1.02 d No explanation should be required since was given in problem that flow was lost. Any reason given why this occured would be strictly hypothetical.

1.03 Either b or c should be allowed as correct, if calculate:

Assume EOC conditions:
I.R. at 100 percent power = 5×10^{-4}
I.R. at S.R. energization = 5×10^{-11} amps
Beta effective = 0.0054
Stable SUR after trip = 1/3 dpm
Reactivity after trip = 7000 pcm

$$P = P_o \, 10^{surt} \qquad \frac{\text{Beta}}{\text{Beta} - \text{Rho}}$$

t = 17.7 minutes

Time to energize from typical shutdown curves from Westinghouse and evolution conducted on simulator (see attached curves) indicate approximately 15 minutes to source range energized.

1.05 b. Rod worth is <u>not</u> affected by increase in the flux level in core, as stated in key. Rod worth for power increase may increase, decrease, or remain constant, depending on flux distribution and location of control rod. (Ref. Large Pressurized Water Reactor Core Control by Westinghouse pg. 6-26)

1.05 c. Effect on rod worth is dependent on location of rod in question relative to the rod moved. If rod <u>inserted</u> is close to one in question, the moved rod will depress the flux in the region and lesson the worth of rods in close proximity. If rod <u>inserted</u> is far away from the rod in question the flux in the region of this questioned rod will increase and its worth will increase. (Ref. Westinghouse Reactor Theory Review Text pgs. I-5.42 and I-5.43).

1.05 d. If a rod is at outer regions of core, but not at edge, it will be at region of highest local flux and will have highest rod worth. Therefore rod worth at outer region of core can be higher than rod worth at inner region of core.

1.09 b.2. Also accept system pressure above which the pump will not produce any flow.

[illegible] Power, [illegible], [illegible], Press, Temp.

1.10 a. Accept RCS flow rate, ~~nuclear enthalpy rise hot channel (F^N) or heat flux hot channel factor (FQ(Z))~~ -Ref. T.S. Bases for 3/4.2.2 and 3/4.2.3 pg B 3/4 2-2.

b. Accept peak linear power density (KW/Ft) - Ref. T.S. Bases for 3/4.2 pg B 3/4 2-1

1.12 a. Also accept limits potential effects of rod misalignment on associated accident analysis - Ref. T.S. Bases for 3/4 1.3 pg B 3/4 1-3.

2.02 a.

- Wording of the question can result in confusion between RPCCW and TPCCW

- The question is not consistent with the normal operation of the system in that we do not operate with a RPCCW pump in standby, ready for an auto start. Both RPCCW pumps are running supplying each trains subheaders with the containment safety related sub-header split by having all inside containment sub-header cross-tie valves closed. The swing pump (P1C) is prevented from operating by electrical and mechanical interlocks with the other pumps operating. Ref: NSSS Text RPCCW Chapter Pages 9-13; RPCCW OP 3330A.

- There is no low discharge pressure auto start feature for RPCCW pumps Ref: NSSS Text RPCCW chapter Pages 9-13.

- RPCCW Pumps are not sequenced on a LOP/CDA Signal Ref: BOP Text Sequencer Chapter Figure 1.

2.04 c. Delete the "RCS Stop Valves Open" from answer key. This has been removed from the AFW Start Logics thus <u>not</u> requiring RCS Stop Valves to be Open to produce an AFW Pump Auto Start. REF: functional logic diagram Figure 7.2-1 Sheet 7 and 15, Amendment 14 dated July 1985.

2.05 Should also accept reactor vessel leakoff flange H. Temperature Alarm and Indication. Ref: P&ID EM 102A-3 and EM 107 A-4, NSSS Text, Reactor Vessel and Internals Chapter PG 8-9.

2.06 b. Correct terminology for RCDT in answer key would be containment drain transfer tank (CDTT)

2.07 b. This part should be delected, as there is no alternate suction for the RHR System from the containment. The Containment Recirc System is the only system to take a suction on containment for long term cooling in recirculation mode. Ref: NSSS Text RHR chapter, P&ID EM 112 A-5.

2.07 d. The RHR pump cold leg discharge isolation valves are closed, not open, while in Cold Leg Recirc. Ref: ES-1.3 Rev 1, Change 1 Page 4 Step 2.b.

2.08 b. The normal configuration for the Containment Instrument Air System is not to run the containment instrument air compressers after fuel load. The containment instrument air system is supplied from the instrument air system through the containment isolation valves. Ref: OP 3332B Objective.

2.10 a. The time delay till the containment recirc system starts has been changed to 660 seconds (11 min). Ref FR Z.1, Rev 1, Page 6, Item 6.b

2.11 During normal operation, PCV 131 maintains a constant backpressure on the letdown orifices, not letdown flow control valves. The letdown pressure control valve is used in both manual and automatic for solid plant pressure control, not exclusively in manual as indicatred in the answer key. Ref: NSSS Text CVCS Chapter Pages 8-13; OP 3201; OP 3208.

3.01 a. Overpower Delta T does not protect against a safety limit.

3.06 a. P-14 coincidence is 2/4 now have levels (Ref: Function Diagrams, Rx Trip Sys., Figure FSAR 7.2-1 (7 of 19)

3.07 Must anticipate candidate assumptions as to which PZR level xmtter he is looking at, since cooldown OP has him use cold-cal level channel (LI-462) and Figure 7.1 to monitor actual PZR level. Ref: OP 3308, step 5.10, Caution 2, Pg 16. Cold-cal instrument (LI-462) will read lower than actual.

assumed hot channel during exam.

3.08 Open - >2200 psia
Control switch to/in auto
COPS Arm/Block to "ARM"

Close - no AUTO signals to close these valves.
(Ref: FSAR Funct. Diag. Fig 7.2.1 (19 of 19)

3.09 a. 1. 2385 psia or 2370 psig (REF: E.O, PLS)

2. 1900 psia/1885 psig (REF: E-O, PLS)

b. Add PORV block, 2/4 detec., 2200 psia
(REF: FSAR Funt. Diag. Fig 7.2-1 (19 of 19) & (6 of 19)

3.13 a. Rad element numbers should not be required in key.

b. Suggest minor credit for trip of supply and exhaust fans because their trips are a cascading effect. ie:
- Rad element close dampers 32 A/B
- Damper closure stops exh. Fan
- Stop of exh. Fan 4A stops supply unit HVU1A
damper numbers should not be required in key.

c. Candidate must assume release path is thru Aux. Bldg. For key to be correct. In addition, several of the process vent monitors available throughout the Aux. Bldg. may indicte activity increase as well as HVR-10. Rad element numbers should not be required in key. REF: LSK 22-1D& 1J, P&ID 148A & 153A.

4.01 a. Key is in error in 2 places for specific numbers.

1. Key has 35% vice 34% for S/G NR levels.

2. Key has 275 gpm vice 525 gpm for FW flow verification.

b. Answer key is correct, however, questions uses wrong level; level should be 520,000 vice 520, 410 gals.

4.02 a. Key should also accept that running pump for 5 minutes will equalize boron concentration to that of RWST (thus raising RHR boron concentration if low)

b. Per OP 3310A the RHR alignment is from RWST thru RHR pump and back to RWST. No mention is made of the flowpath from CVCS, which the key refers to (REF: OP 3310A, Step 7.2)

4.05 a. Per AOP 3552 there are two possible answers to this question depending on where in the procedure you refer to.

Possible answers are:

1. Per the key

2. If QPTR > 1.02, do not increase turbine load, borate as necessary to minimize TAVG-TREF deviation.

b. Key should also accept that the urgent failure is a "Power Cabinet Urgent Failure" due to regulation failure.

4.09 b. Also acceptable:
1500 & 0.5 (current quarterly permanent dosimetry reading)
Up to a maximum of 2500.
(REF: SHP-4902) Step 8.1.2.7)

4.10 b. Key is correct; however question uses 585 psig which is incorrect, should be 660 psig (REF: Op 3201)

4.12 Step 4 of ECA 0.0 says to "Verify AFW flow >525 GPM per intact S/G" just as the key indicates.

Some examiners may answer "Verify AFW Flow >525 GPM TOTAL." This answer should also be acceptable since many examinee's are aware of an error in the EOP's. Attached are the pages from the ERG's that indicate this step should correspond to the value for AFW flow in the heat sink CSF status tree red path. Also attached is a copy of that status tree.

5.01 b. Calorimetrics are not done at different power levels to adjust detectors following initial startup testing.

5.04 a. Question asks "which condition would result in a higher SUR; a rod ejection at BOL or EOL." Answer key says EOL results in a higher peak power level. This is not asked for in the question. A more correct anser would be the smaller B results in a higher SUR at EOL

5.05 1. Question refers to improper use of rod worth curves yet answer does not even mention them. Answer key discusses B from BOL to EOL which has no bearing on this question. Rod Worth curves are not based on B.

A more correct answer should compare rod worth at BOL to EOL and conclude that rod worth increases over life. Since BOL curves are used the reactor will actually go critical below the calculated ECP.

The answer key discussion does not match the answer. Key says criticality would occur sooner than predicted and answer is LOWER however question asks to compare calculated ECP to actual. Therefore your answer should be HIGHER. Refer: Core characteristic's handout)

Wording of question is confusing. Examinees may answer LOWER, implying the actual criticality is lower than the ECP which is generally the way the two are compared.

2. Insufficient information is provided in this question. Examinee needs information about power level before the 12 hour outage discussed in the question in order to estimate xenon for this condition. (Attached figure shows xenon vs. time after trip). Essentially the previous RCD could be at any xenon condition depending on the power level before the outage.

   Also, answer key conclusion is wrong based on reasoning provided. Again, like the previous question the answer key reverses the comparison scheme called for in the question. "Actual vs. ECP", vice "ECP vs. Actual".

5.07 a. Key should also accept, Critical Heat Flux is the heat flux necessary for DNB to occur. Since temperature at core bottom is lower, and pressure is highest, greater margin to DNB, CHF is at its maximum. Discussion of steam quality should not be necessary for full credit.

5.11 d. Answer key is incorrect, if a level detector (controlling channel) fails high, the feed regulating valve will close until level error equals flow error and steam generator level stabilizes at a lower value. Reactor power will settle out to the same level as before.

6.05 With RCS pressure at 1600 psig the SI pumpw ould not be injecting (shut off head for SIH is 1580 PSIG). An estimate of charging pump flow would be approx. 400 gpm. at 1600# assuming it's 150 gpm at about 2250# and 550 gpm at 660#.
(REF: MP-3 NSSS Trng. Topic 3 Lesson 4 Pg 45.)

6.06 For plant condition 3 (Sta. Blackout) the 34C-IT-2 and 34D-IT-2 breakers would be open upon Failure of system to Fast Transfer. In addition the EDG breakers are open. Also, condition 1 has two acceptable answers: RSST or NSST.
(REF: MP-3 Trng. BOP Chap. 4.16 kv.)

6.07 Techincally incorrect. There is no instrument power to the input relay bay.

6.08 b. Should accept "Tref less than Tavg causing Terror for rod insertion."

6.09 Can also block by sequencer test lineup or by AFW SYSTEM valves' being closed.

6.10 c. Estimates can also be made using RCS leakage computer program (or manual calculation), and/or charging/letdown Flow balance. (REF: EOP-3555.)

6.11 a. No effect on SUR and indicated level won't increase at higher than actual rate.

6.13 There is no load called "Aux Air Recirc Fan" - remove from answer key. If this was to mean Ctmt. Air Recirc fans, they do nc. start on CDA. Add "charging pumps" to key, since during LOP the sequencer does not give them a start signal but it does during CDA. Also note that nothing is loaded on diesels during a blackout, by definition. It is not reasonable to expect students to know exact sequences.

7.01 a. The question asks what conditions must exist "By Procedure" to reset a spurious SI actuation. The conditions to terminate SI "Per Procedure" are:

- RCS Subcooling
- Secondary Heat Sink
- RCS Inventory (PZR Level/Pressure)

Credit should also be given for these conditions. (REF: EOP E-0, Rev 1, Page 10, Step 26)

7.02 a. Answer Number 3 is the result of a seal failure, not a condition resulting from A loss of all AC that can lead to (produce) A seal failure. This answer should be deleated fromt he answer key. (REF: Mitigating CORE damage, Chapter 4, Page 4.5)

7.02 b. The following can also be indications of A RCP #1 Seal failure and should also be accepted for full credit:

- #2 RCP Seal leakoff flow high alarm
- An increase in the affected pump Seal water supply flow.
- An increase in the Leakoff Flow Recorder(s).
- Immediate response to a major failure would be a decrease in PZR level and a PZR Level Deviation Alarm.
- An increase in charging flow.

(REF: Dynamic response of the simulator; NSSS Text, RCP Chapter; P&ID EM 103A-4.

c. No comment.

7.04 a. Credit should also be given for exit thermocouples $<1200^{\circ}$ (or $<700^{\circ}F$). There are numerous kickouts in FR C.1 prior to this step that look at CORE Exit Thermocouple Temperature along with Plenum Level and Hot Leg Temperature to verify adequate CORE cooling. (REF: FR-C.1, STEP 5&6, STEP 15 & 16).

7.05 a. The only source of cooling is steam relief out the S/G safeties due to the loss of instrument air and the loss of power to the atomospheric bypass valve on the loss of power. Manual operator action would be required to locally open the atomospheric bypass valves to bleed steam. During the time delay to initiate manual dumping of steam via the atmospheric bypass valve, the S/G safeties will lift to remove CORE decay heat. (REF: Mitigating CORE damage, Chapter 4, Pages 4.8 - 4.12

7.06 Credit should be given for "To prevent a loss of main feedwater pump suction". The minimum flow requirements for two feedwater pumps is greater than the capacity of a single condensate pump is why this condition can occur. This is consistent with the stated reason for the procedural change. (REF: OP 3321, REv 0, Change 5, Change 6)

7.07 Credit should also be given for "Controlling AFW flow to the S/G's" which can result in excessive cooldown, especially at the beginning of cycle. (REF: E-0, Rev 1, Page 8, Step 20 Response not obtained; ES-0.1, Rev 1, Page 3, Step 20 Response Not Obtained; etc.

7.08 b. The answer (reason for procedure words) is to minimize schedule time for fueling sequence.

7.08 d. Credit should also be given for restoring the inoperable instrument to operation to meet the minimum channels operable requirement. The question does not preclude this action as a possible solution. It should be noted that students are not required to memorize Tech. Spec. action statements.

7.09 a. Could also be "Temperature Control Valve" vise "Flow Control Valve". (REF: OP 3201, PAGE 22, Caution).

b. Credit should also be given for 60^{O}F/Hr. This is consistent with Precaution 4.3 of OP 3201 which requires pressure and temperature to be maintained in accordance with Tech. Spec. Figure 3.4-2 which is based on a 60^{O}F/Hr heatup. (REF: OP 3201, page 10, Precaution 4.3 and Tech Spec. Figure 3.4-2 Explanation note at top of Figure)

7.11 c. Other possible answers:

- Required by Tech. Specs.
- Criticality moniotoring.

8.02 No answers correct. Limit ensures $F_Q(Z)$ envelope not exceeded during normal OPs or in event of xenon redistribution following power changes. The reference given for the key answer does not refer to this, but rather refers to why we allow operation outside the target band within time limits. This prevents xenon redistribution from being excessive and causing envelope of peaking factors to be reached. Any answer should be accepted as correct.

8.07 Question given data is misleading. The total leakage given is not defined and does not correlate to any further data given. If use other leakages which are given, identified leakage may be excessive. The number given for leakage past RCP seals does not define where it goes and could be taken to be either part of controlled leakage or unidentified leakage. The identification of excessive RCS Pressure Isolation Valve Leakage would require memorization of a Surveillance table, which is not required of the operators.

8.08 b. Also allow yes with explanation that can't enter Mode 4 (i.e. can only heat up to 200^{O}F)

d. Department head can't approve entry into action statements.

8.10 a. The question requires knowledge not required to be memorized by the operator (i.e. action statement of greater than or equal to one hour).

b. Containment Integrity, as defined, is not required in Mode 6 either. However, a "modified containment integrity" covered under Specification 3/4 9.4 is required during core alterations or movement of fuel in containment. Therefore, Mode 6 should also be accepted as a correct answer.

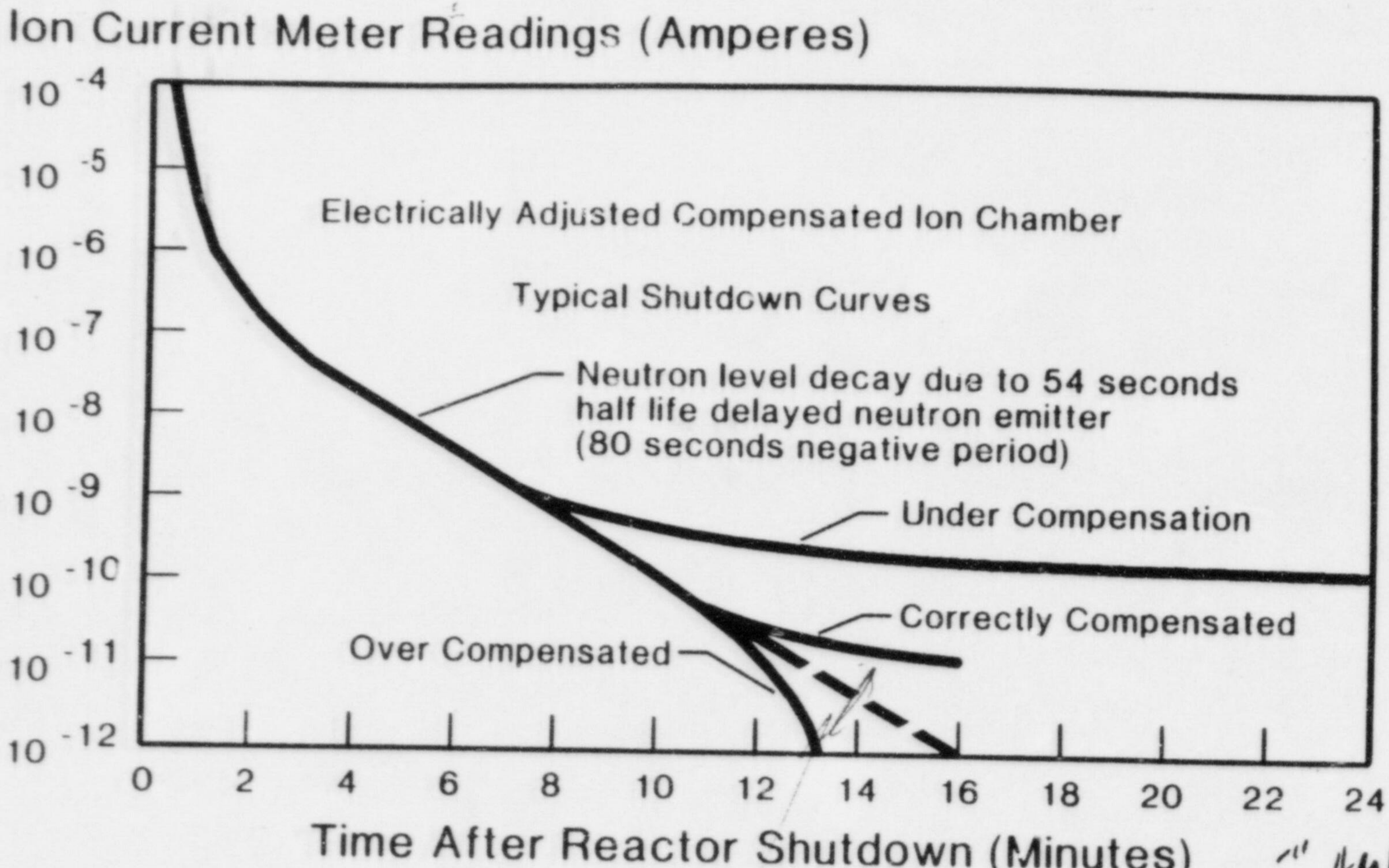
c.2 This involves memorizing action statements and surveillance steps in two separate specifications.

8.12 a. Not enough information to classify.

b. c. & d. Both questions asked to classify events based on the given EPIP Form. The form is wholly inadequate to provide the classification. Apparently, EPIP Forms 4701-3 and 4701-4 were intended to be given with the exam to classify the events and were accidentally left off. These are the forms which the answers in the key are based on. Since the required forms were not provided, any answer justified by the candidate should be accepted for full credit. Incidents require EAL Tables to classify.

For Question 1.03
1.03

GAMMA-COMPENSATED CURVE



137 T22508 1

S.R. energizes when I.R. < 5×10^{-11} AMPS on both detectors

EN-8

ATTACHMENT 4

RESOLUTION OF FACILITY COMMENTS

REACTOR OPERATOR EXAM

1.02 d Question was deleted.

1.03 Answer key was changed to accept "b" or "c".

1.05 b Answer key was changed to reflect a shifting of neutron flux distribution caused by the doppler effect, changes in moderator temperature and buildings of fission product poisons.

1.05 c Either a description or a discussion was accepted

1.05 d Answer key was changed to accept the statement that rods at the outer regions of the core may be of higher worth than central rods.

1.09 b(2) Answer key was changed to accept "system pressure above which the pumps will not produce flow."

1.10 a Answer key was changed to accept RCS flow, FQ(Z), and Figure 2.1-1 parameters.

1.10 b "KW/ft" was added to the answer key.

1.12 a(2) Answer key was modified to accept "limit potential effects of rods misalignment on associated accident analysis."

1.12 b Answer key was modified to accept "higher delta T input to RIL computer."

2.02 a Answer key was modified by deleting "Low pumps discharge pressure (80 psig)" and adding "Normal CC W pump not running."

2.04 c "Stop valves open" was deleted from the answer key.

2.05 "Alarm indication" was added to the answer key but was not required for full credit.

2.06 b "RCDT" was changed to "CDTT" in the answer key.

2.07 b Question was deleted.

2.07 d Answer key for CL RECIRC was changed from "open" to "closed."

2.08 b Question was deleted.

2.10 a Answer key was changed from "5 minutes" to "11 minutes."

2.11 Answer key was changed to reflect control of pressure on letdown orifices and manual and automatic control of the letdown pressure control valves.

3.01 a No change was made to the answer key. Overpower delta temperature protects the core from overpower conditions as stated in RPSAS Lesson Plan page 49.

3.06 a(1) Answer key was changed from "2/3" to "2/4" coincidence.

3.07 Candidates were directed to assume the "hot channel" level indication during the examination.

3.08 Answer key was change to reflect current facility conditions by deleting the answer for closing.

3.09 a Answer key was changed to reflect current facility setpoints.

3.09 b "PORV block at 2200 psia" was added to the answer key.

3.13 a The element number was not required for full credit.

3.13 b Answer key was restructured to include the cascading effect of the exhaust fan trips.

3.13 c Additional answers were accepted if they could be supported by facility documentation.

4.01 Plant specific numbers were used in place of generic values.

4 02 a Answer key was modified to accept alternate answer of "equalize boron concentration in RCS with RWST."

4.02 b Answer key was change to require the flow path from the RWST thru the RHR pump and back to the RWST.

4.05 a Answer key was changed to include "or buration as necessary."

4.05 b Answer key was modified to also accept "Urgent Failure due to regulator failure."

4.09 b Answer key was changed to require "2500 mr/qtr and 1500 + 0.5 current quarterly permanent dosimetry reading.

4.10 b The value of 585 psig is in accordance with the reference material provided for examination preparation.

4.12 Answer was key modified to accept either total flow or intact S/G flow.

SENIOR REACTOR OPERATOR EXAM

5.01 b "At various power levels" was deleted from the answer key.

5.04 a Answer key was changed to "higher SUR at EOL."

5.05 1. Answer key was changed to "higher."

2. Answer key was changed to "higher." Candidates were directed to assume the same 60-day power history that was established in the stem statement.

5.07 a The statement concerning the formation of steam bubbles was not required for full credit.

5.11 d Answer key was changed to "lower; bypass FRV will close until flow error offsets level error. RX trip will occur when actual level decreases (to 30% on 2/4 detectors in 1/4 SG)."

6.05 Answer key was changed to the approximate flow rate of one charging pump.

6.06 Answer key was changed to include the assumption that the NSST is available.

6.07 Answer key was not changed.

6.08 b Answer key was not changed.

6.09 Answer key was modified to include "sequencer test lineup" and "AFW pump suction valves closed."

6.10 c Answer key was modified to include "charging/letdown flow balance" and "RCS inventory computer program."

6.11 a The reference material does not support any change to the answer key.

6.13 Answer key was modified by replacing "Aux Air Recirc Fan" with "Charging Pump." No reference material was provided to support this modification.

7.01 a Question was deleted.

7.02 a No change was made to the answer key since all responses were considered correct.

7.02 b Answer key was changed to accept five additional correct responses.

7.04 a Answer key was modified to accept "Core Exit Thermocouples."

7.05 a Answer key was changed to include:

"Secondary Safeties and PORV's."

7.06 Answer key was changed to include "caused by loss of main feedwater pump suction."

7.07 Answer key was changed to also accept "throttle AFW flow."

7.08 b No change was made since answer was in accordance with reference material.

7.08 d Answer key was changed to include "Restore the inoperable instrument to service or...."

7.09 a No change was made since answer was in accordance with reference material.

7.09 b Half credit was given for "60°F/hr."

7.11 c Answer key was changed to include "criticality monitor" and "required by technical specifications."

8.02 Question was graded to the answer key since no supporting documentation was provided.

8.07 Question was graded to the answer key.

8.08 b Answer key was changed to also accept "Yes; Provided 200°F was not exceeded."

8.08 d Answer key was changed by deleting the approval of department head.

8.10 a Answer key was not changed.

8.10 b No deduction was made for including "Mode 6" in the answer.

8.10 c(2) Partial credit was given for FOX.

8.12 Question was deleted.