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

EXAMINATION REPORT NO. 85-21 (OL)

FACILITY DOCKET NO. 50-245

FACILITY LICENSE NO. DPR-21

LICENSEE: Northeast Utilities Service Company
P. O. Box 270
Hartford, Connecticut 06141-0270

FACILITY: Millstone Unit I

EXAMINATION DATES: August 12 - 15, 1985

CHIEF EXAMINER: _____ 11/25/85
Frank Crescenzo, Reactor Engineer (Examiner) Date

REVIEWED BY: _____ 11/26/85
David Lange, Lead Reactor Engineer (Examiner) Date

REVIEWED BY: _____ 11/26/85
Robert M. Keller, Chief Date
Projects Section 1C

APPROVED BY: _____ 12/2/85
Harry B. Kister, Chief Date
Project Branch No. 1

SUMMARY: Written and oral examinations were administered at Millstone Unit I the week of August 12, 1985. Six Reactor Operator and four Senior Reactor Operator candidates were examined. One Reactor operator candidate and one Senior Reactor Operator candidate failed both the written and oral examinations.

REPORT DETAILS

TYPE OF EXAMS: Replacement X

EXAM RESULTS:

	RO Pass/Fail	SRO Pass/Fail
Written Exam	5/1	3/1
Oral Exam	5/1	3/1
Overall	5/1	3/1

1. CHIEF EXAMINER AT SITE: Frank Crescenzo

2. OTHER EXAMINERS: Brian Hajek, Tom Morgan

3. Summary of generic strengths or deficiencies noted on oral exams:

   Overall, the candidates performed well on the walkthrough; however, weaknesses were noted in knowledge of control systems i.e., MPR/EPR Turbine Control, Recirc Flow Control.

4. Personnel Present at Exit Interview:

   NRC Personnel

   Frank Crescenzo

   NRC Contractor Personnel

   Tom Morgan (EG&G, Idaho)

Facility Personnel

W. Romberg, Station Superintendent
R. Test, Director, Nuclear Training
R. Palmeri, Operations Supervisor, Unit I
M. Jensen, Training Supervisor, Unit I
G. Sturgeon, Training Instructor, Unit I
D. Meekhoff, Training Instructor, Unit I

5. Summary of NRC Comments made at exit interview:

   a. The preliminary results of the oral exams as noted in paragraph 3 were discussed.

   b. The plant staff and training staff were cooperative during the examination period.

Attachments:
1. Written Examination and Answer Key (SRO/RO)
2. Written Examination and Answer Key (RO)
3. Facility Comments on Written Examinations made after Exam Review
4. NRC resolutions to facility comments on Written Examinations

Attachment 1

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

FACILITY: MILLSTONE 1

REACTOR TYPE: BWR-GE3

DATE ADMINISTERED: 85/08/13

EXAMINER: CRESCENZO, F.

APPLICANT: Master

INSTRUCTIONS TO APPLICANT:

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

CATEGORY VALUE	% OF TOTAL	APPLICANT'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.00			5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.00			6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
25.00	25.00			7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.00			8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
100.00	100.00			TOTALS

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

QUESTION 5.01 (1.00)

During a rapid power increase, very short periods can be maintained, yet for rapid power decreases, the period quickly becomes -80 sec. Explain. (1.00)

QUESTION 5.02 (3.00)

When the reactor is at full power and a feedwater controller malfunction results in the closure of both feedwater regulating valves, a reactor scram is expected to occur within approximately 8 seconds. During that time period, is the reactor power level expected to INCREASE, DECREASE, or REMAIN CONSTANT? Give two (2) reasons for your answer. (3.00)

QUESTION 5.03 (3.00)

Regarding the xenon transient following a significant DECREASE in reactor power from high power operation:

a. HOW will peripheral control rod worth be affected (INCREASE, DECREASE, REMAIN THE SAME) during the xenon peak? BRIEFLY EXPLAIN your answer. (1.50)

b. If the decrease in reactor power was from 100% to 50%, would the new (50% power) equilibrium xenon reactivity be MORE THAN, LESS THAN or EQUAL TO one half the 100% equilibrium value? Briefly, JUSTIFY your answer. (1.50)

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

QUESTION 5.04 (2.50)

With regard to the MAPLHGR thermal limit:

a. Briefly, WHAT is the reason, or bases for having a MAPLHGR thermal limit? (1.00)

b. WHICH TWO of the following four parameters affect the MAPLHGR LIMIT? (0.50)

1. Moderator Temperature
2. Type of fuel
3. Fuel exposure
4. Reactor pressure

c. If an P-1 is selected on the Process Computer, the program provides, among other things, MAPRAT. WHAT is the relationship between MAPRAT and MAPLHGR? (1.00)

QUESTION 5.05 (3.00)

The figure below represents six fuel assemblies within a critical reactor. Why would an operator expect a higher than normal rod worth associated with control rod B-2. (3.00)

X= control rod fully inserted
O= control rod fully withdrawn

1.	X	O	X
2.	O	X	O
3.	X	O	X
	A.	B.	C.

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

QUESTION 5.06 (2.00)

Indicated reactor water level at 100% power differs from the actual water level above the core (that which is present in the steam separators or within the dryer skirt).

a. Which level (actual or indicated) is higher and by how many inches? (1.00)

b. Explain why the above difference occurs. (1.00)

QUESTION 5.07 (2.00)

The plant is operating at 90% power. Extraction steam to the HP feed water heaters is shut off. A visitor, observing that turbine load has increased by 20 MWE after extraction steam was shut off, concludes that this action has improved the plant's thermodynamic efficiency. Do you agree or disagree? Explain using relevant plant indications to support your position. (2.00)

QUESTION 5.08 (3.00)

a. For the centifugal pump characteristic curve attached to this exam, show how the system operating curve will change and explain why the change occurs if a valve in the discharge of the pump is throttled one-half closed such as might be the case in the feedwater control system. Be sure to label all points and lines. (1.50)

b. The recirculation system uses changes in pump speed to control flow rate. Using the same figure, explain which flow control system is more efficient. (1.50)

NOTE: You may detach the figure for use in your answer.

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

QUESTION 5.09 (2.50)

During a reactor startup, the neutron count rate measured on the SRM's has increased to 500 cps at which point the Reactor Engineer states that Keff is 0.99. The reactor operator withdraws eight control rods an additional two notches each. The count rate increases to 4000 cps. Is the reactor critical? Justify your answer with at least two arguments or methods. (2.50)

QUESTION 5.10 (3.00)

a. A relief valve is stuck open resulting in a flow of steam to the suppression pool. The suppression chamber initially contains 120,000 ft**3 of water at 70 degrees F. How much heat must be added by the relief valve to raise the suppression pool water temp. to 100 degrees F if the specific heat of water is 1 BTU/lbm-F? (1.50)

b. What would be the temperature of the piping downstream of the relief valve if reactor pressure were 1000 psig and the suppression chamber at 1 psig.? (1.50)

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

QUESTION 6.01 (2.00)

Immediately following a reactor scram all the green full-in lights on panel 905 will be illuminated but there will be no rod position readout displayed. Assuming NO operator action is taken to reset the scram signal, it will take a period of time before the "00" position readout is obtained. BRIEFLY EXPLAIN the reason for this observed response; address BOTH the source(s) of the observed indications (green light,"00") and the reason for the delayed "00" readout. (2.00)

QUESTION 6.02 (3.00)

Answer the following for the F.W.C.I. system:

a. For a F.W.C.I. auto initiation during a L.O.C.A. the flow in the F.W. header for the operating pump combination reaches 105% of maximum normal flow. What affect will this have on the F.W. regulating valves initially, and as pressure decreases? (1.00)
b. In the above condition, with the flow at 105%, why would you not want to press the F.W. flow control reset button on panel 905? (1.00)
c. During a F.W.C.I. system initiation, the block valves associated with the F.W. string selected were in the closed position. Will the system inject? (yes or no and why) (1.00)

QUESTION 6.03 (3.00)

Concerning the recirculation pump seal assembly, describe what indications/alarms would be seen in the control given the following system failures.

a. Failure of no. 1 seal only. (1.00)
b. Failure of no. 2 seal only. (1.00)
c. Failure of both seals. (1.00)

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

QUESTION 6.04 (2.00)

Concerning startup of a recirculation pump:

a. When do the "A" contacts within the voltage regulating circuitry shift from the 120 VAC system to the self excitation mode? (0.50)
b. When does the field breaker close and why is there a delay in closing? (0.50)
c. What conditions will cause the generator lockout relay to trip on incomplete start sequence and what breaker(s) will trip? (1.00)

QUESTION 6.05 (1.50)

Temperature indication for the CRD mechanisms is monitored by thermocouples in the RPIS probes.

a. Where does this temperature indication readout and at what temperature will an alarm be received? (0.50)
b. Why is it necessary to monitor this temperature? (2 reasons) (1.00)

QUESTION 6.06 (2.50)

Assume a valid Group 4 isolation exists to answer the following:

a. What signals will cause a group 4 isolation? (0.50)
b. Could valve IC-3 be opened? could it be throttled open? Include in your answer why it could or could not be throttled. (1.00)
c. How can the operator reset the isolation ? (assuming a valid signal no longer exists) (1.00)

QUESTION 6.07 (1.00)

Why is it necessary to maintain the ESW system pressurized via SW when ESW is not in use? (1.00)

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

QUESTION 6.08 (3.00)

Describe the response of the vital AC system subsequent to the following malfunctions. Include in your answer whether vital equipment may be lost and why. (Do not list equipment lost)

a. Loss of 480 volt bus E-5. (1.00)
b. Loss of 480 volt bus E-5 for an extended period of time,(> 8 hrs), with no operator action. (1.00)
c. Subsequent to malfunction "b" above, 480 volt bus E-5 is re-energized. (1.00)

QUESTION 6.09 (2.00)

Concerning a scram on low air pressure in the scram pilot valve air header.

a. What is the purpose of this scram? (1.00)
b. When is this scram bypassed? (1.00)

QUESTION 6.10 (1.00)

A standby power supply for the gas turbine auxilliaries is from MCC F-4 however, this source should not normally be used. Why is this? (1.00)

QUESTION 6.11 (2.00)

Choose the correct statement(s) concerning the APR system. If any part of the statement is incorrect, consider the entire statement incorrect. (2.00)

a. Assuming APR has initiated, the valves may be closed by opening ckt. bkr. DC 11A-2 #21 (125 VDC power supply to APR logic and solenoids).
b. There are 4 APR trip logic channels. Channels A-1 and A-2 work as a pair and function identically in a two out of two once logic.
c. Assuming APR has initiated, the valves will not auto close when reactor reactor water level increases to above - 48 inches.
d. For each SRV remote manual switch (RMS) there is a green and red lamp. The red lamp will only illuminate when the RMS is in the OPEN position or if an auto blowdown signal is recieved.

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

QUESTION 6.12 (2.00)

According to OP 336, Core Spray System, the "Core Spray Header A (B) Hi Dif Pressure" alarm windows are normally in an alarmed state at cold shutdown or as cold conditions are approached as the reactor is being shutdown.

a. During normal reactor power operations, what is indicated if one of these windows alarms? (1.00)

b. Why are the windows normally showing alarmed status when the reactor is cold? (1.00)

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

QUESTION 7.01 (3.00)

a. Using the attached copies of figures 2 and 8 from procedure EOP-580, Containment Control, determine the minimum suppression pool water level allowable given the following plant conditions.
1. RPV pressure = 500 psig
2. Suppresion pool temperature = 170 deg. F.
NOTE: show all calculations (2.00)

b. If suppression pool water level cannot be maintained above the curve on figure 2, the procedure directs the operator to commence emergency RPV depressurization. What is the basis for this procedural step? (1.00)

QUESTION 7.02 (2.00)

Operators are cautioned against bypassing of feedwater heaters other than the HP heaters. Why is this? (2.00)

QUESTION 7.03 (3.00)

Regarding the CRD System Operating Procedure (OP-302):

a. During operation at RATED power, the rod position indicator gives evidence of rod drive DRIFT OUT following a withdraw signal. WHAT THREE (3) immediate operator actions are required? (1.50)

b. 1. WHEN must the CRD hydraulic system be in operation? (0.75)
2. WHEN should the CRD hydraulic pumps NOT take a suction from the Hotwell Reject Line? (0.75)

QUESTION 7.04 (3.00)

Concerning Procedure OP-201 (Approach to Criticality)

a. WHAT checkoffs must be performed prior to Unit Startup? (1.0)

b. WHO'S permission is required to take the reactor critical? (3 REQUIRED) (1.0)

c. WHAT information is recorded in the Shift Supervisors Log WHEN criticality is achieved? (7 REQUIRED) (1.0)

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

QUESTION 7.05 (1.50)

With the Reactor operating above 5 % thermal power during a plant heat-up OP-202 (Plant Heatup) cautions the operator to remove the Mechanical Vacuum Pump from service once condenser vacuum reaches 23" Hg .

a. Explain the reason for this step including any adverse consequences resulting from leaving the pump in service . (1.50)

QUESTION 7.06 (3.00)

OP-206, Plant Cooldown to Cold Shutdown, cautions that when both reactor recirculation pumps are off, reactor vessel level must be maintained above + 50 inches.

a. What is the reason for this precaution? (1.00)

b. What additional precautions must be taken if level cannot be maintained above +50 inches? (2.00)

QUESTION 7.07 (1.75)

Procedure OP-207, Scram Recovery, requires a check to be performed following a scram to ensure a Limiting Safety System Setting was not exceeded. How can this be checked? (1.75)

QUESTION 7.08 (1.50)

a. State the temperature range within which the RBCCW heat exchanger outlet temperature should be maintained. (0.50)

b. When is it permissible to use the RBCCW heat exchanger Service Water outlet butterfly valves 1-SW-6A, 6B, 6C, to regulate RBCCW heat exchanger outlet temperature? (1.00)

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

QUESTION 7.09 (2.00)

OP-329, Standby Gas Treatment, section 7.4.3, (establishing a cooling air flow path to remove decay heat from SGTS filter train), cautions that the non-operating SGTS train must be manually placed into service PRIOR TO opening the cooling air damper 1-SG-7A(1-SG-7B). What is the reason for this caution? (2.00)

QUESTION 7.10 (1.50)

Using the attached copy of Unit 1's Emergency Action Levels, classify the following events. Consider each event independently.

a. LOCA inside drywell with rapid depressurization. Core Spray pump "A" fails to start. (0.25)
b. Threat of multiple bombs on site, one bomb has been located in turbine building, currently being disarmed. (0.25)
c. Thunderstorm on site wind speed burst of 82 MPH. (0.25)
d. Malfunction in radwaste facility resulting in release rate which corresponds to 2 REM W.B. at max. offsite location. (0.25)
e. ARM on refueling floor indicates 1200 mr/hr, fuel handling in progress. (0.25)
f. Injured man on refuel floor. REM/Hr noted during exam (0.25)

QUESTION 7.11 (1.25)

List the immediate actions upon a loss of all station A.C. power. (1.25)

QUESTION 7.12 (1.50)

Regarding procedure ONP 511, Plant Shutdown From Outside The Control Room.

a. Following an evacuation of the control room, where should the SS and SCO report to? (0.50)
b. If the reactor was not scrammed prior to evacuation, how should the operator scram the reactor from outside the control room? (Assume Main Condenser and feedwater are available) (0.50)
c. How is a scram from outside the control room verified? (0.50)

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

QUESTION 8.01 (2.25)

With the plant in cold shutdown, during your shift, the Chief Maintenance Engineer requests that a Vital Area be re-classified to a Non-Vital status to expedite personnel access performing maintenance activity.

a. What operational criteria must be met prior to your approval ? (1.00)
b. When must the area be re-classified back to a Vital Status once maintenance work is completed and what must be done prior to this re-classification ? (1.25)

QUESTION 8.02 (3.00)

Concerning ACP-QA-9.02 (Station Surveillance Program);

a. During your shift an LCO. occurs that requires pump and valve operability surveillance requirements be met for the FWCI sys. Can these subsystems be assumed to be operable ? If not, why. If so, under what conditions. (1.00)
b. What is the specified allowable time interval for the following test frequencys.
   1. Daily Surveillance Tests (0.33)
   2. Monthly Surveillance Tests (0.33)
   3. Quarterly Surveillance Tests (0.34)
c. What is the maximum allowable extension period for surveillance test intervals ? (1.00)

QUESTION 8.03 (3.00)

With the mode selector switch in "RUN", the MSIV's go shut at 825 psig.

a. WHAT does this isolation provide protection against? (1.00)
b. WHAT undesirable plant operations (i.e., parameters/conditions) does the resulting scram prevent? (2.00)

QUESTION 8.04 (1.25)

Is an SRO required to be present on the refuel floor for the change out of an LPRM detector? WHY OR WHY NOT? (1.25)

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

QUESTION 8.05 (3.00)

During refueling operations, on the 4.00pm to 12.00 midnight shift, the I & C Engineer informs you that the (A) S.G.T.S. failed to meet the flow operability requirements (according to procedure) during surveillance testing. Using the attached copy of Technical Specifications can refueling operations continue? If not, WHY. If so under WHAT CONDITIONS? (3.00)

QUESTION 8.06 (2.00)

The reactor is operating at 100% reactor power and 100% recirculation flow with the two recirculation pump speeds within 10% of each other. During a routine surveillance, it is found that indicated total core flow is 12% greater than previously established power-core flow relationships. Using the attached technical specifications, can the plant continue to operate under these conditions? Reference any sections of the T.S. used in your answer. (2.00)

QUESTION 8.07 (2.50)

List the shift manning requirements (per tech specs) for the following situations.

a. Shutdown Condition with core alterations in progress. (1.25)
b. Shutdown with average coolant temperature greater than 212 F. (1.25)

QUESTION 8.08 (1.25)

TRUE OR FALSE:

a. It is allowable to lift tags from equipment and temporarily operate that equipment without clearing the tags from the tag log. (0.25)
b. Blue tags are placed on electrical equipment only. (0.25)
c. Only operations department personnel are allowed to place or clear safety tags. (0.25)
d. The on-shift SS/SCO are the only persons authorized to issue safety tags. (0.25)
e. More than one job order may be used for a tagout, provided the SS/SCO is aware of its use. (0.25)

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

QUESTION 8.09 (2.00)

Using the attached Tech. Specs, and given the following plant conditions, determine the allowable time that the reactor may continue operating:

a. It is discovered that the "B" LPCI heat exchanger inlet valve is shut and cannot be opened. (1.00)
b. Within the next few minutes, it is discovered, (in addition to the conditions of part a above), that the "A" LPCI pump is inoperable. (1.00)

QUESTION 8.10 (1.00)

According to Tech Specs section 6.9, which of the following events requires prompt notification of the NRC with a written followup report. (More than one answer may be required) (1.00)

a. Abnormal degradation discovered in the reactor coolant pressure boundary.
b. A calculated reactivity balance indicating a shutdown margin less conservative than specified in the technical specs.
c. Conditions leading to operation in a degraded mode permitted by a limiting condition for operation.
d. Plant shutdown required by a limiting condition for operation.

QUESTION 8.11 (3.00)

The reactor is operating at high power. A TURBINE TRIP occurs causing a scram on HIGH FLUX:

a. HAS a violation of the Technical Specifications occured? WHY OR WHY NOT? (1.50)
b. WHAT action(s) are you as the Shift Supervisor required to take? (1.50)

QUESTION 8.12 (.75)

An "Alert" status has been declared during a refueling outage. Are the EPIP functions of the STA required? If so, who will perform these functions? (0.75)

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

Master

5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 5.01 (1.00)

The period during power increases is governed by how quickly the neutron population can increase. The same holds true on a power decrease however, the neutron population is dominated by the longest lived delayed neutron precursor. This decays with ~80 sec. period. (1.00)

REFERENCE
Millstone Reactor Theory pg. 3-45 FJC 67

ANSWER 5.02 (3.00)

DECREASE.[0.5]

REASONS: 1. Immediately the loss of feedwater flow causes a decrease in moderator subcooling which introduces negative dk/k into the core.[1.0]

2. When feedwater flow drops below 20% (~3 sec into trans.) the recirc pumps auto runback to 28%. The decrease in core flow causes an increase in voiding which also adds neg. dk/k into core.[1.5]

REFERENCE
Millstone Rx Theory & Recirc Flow Cont. L.P. FJC 77

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 5.03 (3.00)

a. Peripheral rod worth will increase [0.3] because the highest xenon concentration will be in the center of the core [0.3] where the highest flux existed previously [0.3]. This will suppress the flux in the center of the core [0.3] and increase the flux in the area of the peripheral rods, thereby, increasing their worth [0.3].

b. More than one half the value at 100% power [0.5].
The Xenon production rate is directly proportional to power level, but removal rate is proportional to Xenon concentration and it contains a power dependant term, thermal neutron flux.[0.50]
Since flux is directly proportional to power level the burnout term becomes less significant. This results in an equilibrium Xenon value which is lower than the original equilibrium value but greater than one half the original concentration.[0.50]

REFERENCE
Millstone Rx Theory ppg. 6-7, 6-12. FJC 78

ANSWER 5.04 (2.50)

a. Minimize fuel damage during a DBA LOCA by limiting the peak clad temperature (to < 2200 F) -OR- limiting bundle stored energy. (1.0)

b. 2 and 3. (0.5)

c. MAPRAT = MAPLHGR/LIMLHGR -or- = MAPLHGR/MAPLHGR limit (1.0)
-or- = (MAPLHGR) actual/ (MAPLHGR) LCO max

REFERENCE
Millstone Thermo. pg. 8-25 to 8-28 FJC 79

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 5.05 (3.00)

With control rods A-1, B-1, B-3, and C-2 withdrawn, and B-2 still fully inserted, the "effective" core consists of four small four-bundle reactors. Each is essentially uncoupled because neutrons from one can't pass through the inserted control rod. By withdrawing the control rod, 16 bundles are immediately coupled into one 20 bundle reactor. Thus the size of the control rod is effectively much larger than its actual physical size would suggest, and its rod worth is large. (3.00)

REFERENCE
Millstone Rx Theory pg. 5-17 FJC 80

ANSWER 5.06 (2.00)

a. Indicated is higher. (0.5)
7-10 inches higher (0.5)
b. Indicated level is sensed outside the dryer skirt. (0.5)
Steam flow through the steam separator/dryer at 100% causes a backpressure of 7-10 inches H2O. (0.5)

REFERENCE
Millstone Vessel Instrumention LP pg. 15 FJC 81

ANSWER 5.07 (2.00)

Disagree. (0.5)
Thermodynamic efficiency compares energy in to versus energy out. The increase in generator output resulted from decreasing the amount of extraction steam diverted to the HP FW heaters (0.5)
This condition requires additional energy output from the reactor to raise feedwater temperature to the same saturation temp as before. (0.5)
This is evidenced by a decrease in feedwater temperature and an increase in reactor power or MWT. (0.5)

REFERENCE
Millstone Thermodynamics chap. 4 FJC 82

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 5.08 (3.00)

a. Throttling the valve causes more friction losses in the system and the system curve moves to the left. (1.00)

b. Changing pump speed is more efficient since a lower flow rate can be achieved without increasing the pump head. Increasing pump head, as with throttling, requires more power. (1.00)

(correct drawing required) (1.00)

may also discuss system efficiency, thermo, and operational efficiencies

REFERENCE

Millstone Thermodynamics chap. 12 FJC 84

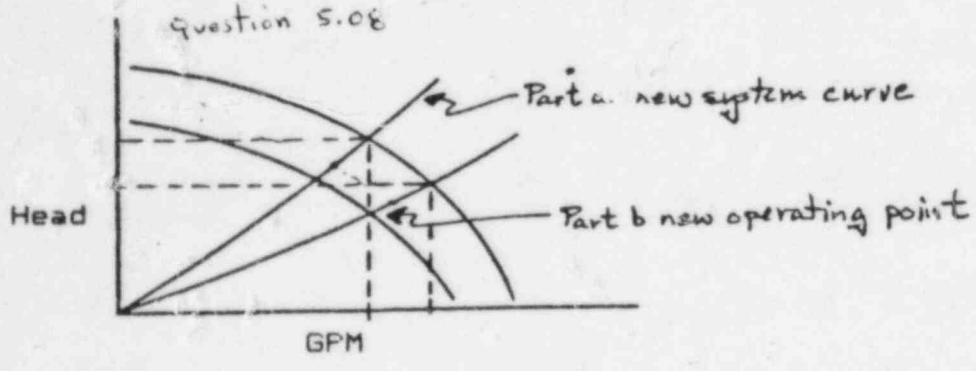


Figure 1.1. Pump Characteristic Curve

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 5.09 (2.50)

No. (0.50)

1. If the count rate has leveled off, that is, it is not continuing to increase at a steady rate without additional control rod motion, the reactor is not critical. (1.00)
2. From the equation CR1/CR2 = (1-K2)/(1-K1), it can be shown that K2=0.99875 OR using the count rate doubling technique, -- the same result can be shown. (1.00)

pressure, but the EHC senses this and opens the TCV's to maintain pressure and increase turbine output. At point 4 the rise in power in the reactor is terminated by negative reactivity insertions from the void and fuel temp. coefficients.
At point 5, the reactor power has stabilized at a new value, with core net reactivity again at zero. (0.75 for ea. no. 2-4)

REFERENCE
Millstone Reactor Theory, ppg. 3-5 thru 3-15 FJC 85

ANSWER 5.10 (3.00)

a. Q= (120,000 ft**3)(62.3 lbm/ft**3)(100-70)(1 BTU/lbm-F)
Q=224,280,000 BTU (1.50)
b. 300 F +,- 10 F (Isenthalpic expansion across SRV answer from Mollier diagram) (1.50)

REFERENCE
Millstone Thermo pg. 1-50 and chap 2 FJC 86

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 6.01 (2.00)

Before the SDV is full the rods will be held in an overtravel position due to a large d/p across the drive piston, and the overtravel reed switch will illumimate the green full-in light [1.0]. When the SDV is full there will no longer be a d/p across the piston and the rod will settle and close the '00" position reed switch.[1.0]

REFERENCE
Millstone L.P. CRD HYD. SYS, Rev 1, pg. 29 FJC 87

ANSWER 6.02 (3.00)

a. The F.W. reg valves will shift from level control to flow control. (0.5) Flow control will limit flow to 105%. As reactor pressure decreases, the F.W. reg valves will modulate closed (0.5)
b. Pressing the F.W. flow control reset button with flow at 105% will ~~not allow reset to the flow control mode and~~ set up a condition to cause pump runout. Force a reset to level control and (1.00)
c. Yes. The block valves open (if closed) (within 43 seconds.) (1.00)

REFERENCE
Millstone L.P. # 1334, pg. 4-5 and O.P. #334 pg. 8 FJC 89

ANSWER 6.03 (3.00)

a. No. 2 seal pressure would approach no. 1 seal pressure. Leakage through no. 2 orifice will go to 1.1 gpm [illegible]. A will alarm at 0.9 gpm (1.00)
b. No. 2 seal pressure would drop upon magnitude of the failure. Leakage thru FS B would exceed 0.25 gpm and alarm high. (1.00)
c. Total leakage out of the seal system would approach 60 gpm as limited by the breakdown bushing. Both FS A and B would alarm high. Pressure in both seals would drop dependent on the magnitude of the failure. (1.00)

REFERENCE
Millstone L.P. 1301A Rev. 2 Figure 3 FJC 90

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 6.04 (2.00)

a. 8 seconds after closing of the drive motor breaker. (0.50)
b. 10 seconds after closing of the drive motor breaker. This is to allow speed to increase to 80% for breakaway torque. (0.50)
c. 32 seconds after closing of the drive motor breaker if < 2.5 psid sensed across the pump. This will trip both the drive motor breaker and the field breaker. (0.50) (0.50)

REFERENCE
Millstone L.P. #1301B Rev 3 pg. 12 and 16 FJC 91

ANSWER 6.05 (1.50)

a. Indication reads out in the control room on a multipoint indicator. Alarms at 250 F (0.50)
b. Warns of high temperature which can damage internal CRD seals and gives indication of leaky scram outlet valves. (1.00)

REFERENCE
Millstone L.P. 1302B Rev. 1 pg. 18 FJC 92

ANSWER 6.06 (2.50)

a. 300% steam or condensate flow within the IC system (0.50)
b. Yes, No,will not throttle if auto initiation or isolation signal exists. (1.00)
c. Take the operators for the valves which isolated (IC-1,2,3,4) to close and reset at CRP 903. (1.00)

REFERENCE
Millstone L.P. 1307 Rev. 2 pg. 6-7 FJC 93

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 6.07 (1.00)

To prevent an unmonitored radioactive release from the LPCI HX (1.00)

REFERENCE
Millstone L.P. 1309 Rev. 2 pg. 23 FJC 94

ANSWER 6.08 (3.00)

a. Upon loss of bus E-5, the AC motor will be lost and power for the generator will shift to the DC motor. Vital loads should not be lost due to the flywheel assembly which will maintain voltage and freq during the transfer. (1.00)
b. When the battery which is supplying the DC motor depletes after approx. 8 hrs., the generator will eventually shutdown causing an ABT shift to the alternate AC powered from IV-1(f-5). Loads may be lost due to the non sync break before make. Also the generator output breaker will open on undervoltage. (1.00)
c. When power is restored, the MG set will re-energize via the DC supply. In 15 minutes it will transfer to the AC supply however the output breaker must be closed manually. (1.00)

REFERENCE
Millstone L.P. Vital AC pg. 2-3 and O.P.-343 rev 5, pg. 8 FJC 95

ANSWER 6.09 (2.00)

a. To eliminate the consequence of a slow scram (random rod insertion) upon loss of air header pressure to the scram valves . (1.00)
b. Mode switch in shutdown/refuel and the S.D.V. bypass switch in bypass. (1.00)

REFERENCE
Millstone L.P. 1408 Rev. 2, R.P.S., pg. 18 FJC 99

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 6.10 (1.00)

MCC F-4 is shed during LNP thus the G.T. auxs. would be powered from the battery which would eventually deplete and shutdown the gas turbine. (1.00)

REFERENCE
Millstone L.P. 480 VAC dist. pg. 10 FJC 100

ANSWER 6.11 (2.00)

a. Incorrect (There are two supply breakers) (0.50)
b. Incorrect (A-1, A-2 do not function identically) (0.50)
c. Correct (0.50)
d. Correct (0.50)

REFERENCE
Millstone L.P. 1337 Rev. 2 pg. 8-11 and O.P. 344A Rev 7 pg. 3 FJC 101

ANSWER 6.12 (2.00)

a. The alarm indicates a possible loss of integrity of the header between the shroud and the vessel wall. (1.00)
b. The dP sensors are calibrated for hot conditions. Sensed pressure will decrease with decreasing temperature of the reactor. (Normal reading is 4 psid, and the alarm point is 2 psid.) (1.00)

REFERENCE
OP 336, section 8.3 and 8.4, LP # 1336, ppg. 10-11, and fig. 6. FJC 128

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 7.01 (3.00)

a. From figure 8, maximum suppression pool temperature for RPV pressure of 500 psig is approximately 178 degrees F. Subtracting 170 from 178 gives a delta temp. of 8 degrees F. From figure 2, minimum suppression pool water level corresponding to 8 degrees F is approximately ~~19~~ 12 feet. (2.00)

b. Delta T (heat capacity) is compared to pool level to determine if sufficient water is available to assure complete steam condensation on a RPV depressurization. (1.00)

REFERENCE
Millstone EOP 580 Rev. 1, Containment Control FJC 40

ANSWER 7.02 (2.00)

1. An unbalanced axial thrust will develop on the turbine shaft if a HIP or IP is removed from service. (1.00)
2. Excessive steam flows in other in-service heaters will cause tube vibration or excessive condensate flows. (1.00)

REFERENCE
Millstone L.P. 1346/1348 Rev 1 pg. 13 FJC 102

ANSWER 7.03 (3.00)

a. Actions on abnormal rod motion:
   1. Attempt to stop the motion with an insert signal, (0.5)
      if motion continues, scram the rod. (0.5)
   2. Reduce recirc flow to maintain rated power at <2011 MWT (0.5)

b. 1. It must be in operation whenever the reactor is critical and whenever the vessel is hot. (0.75)

   2. When the possibility of high condensate conductivity exists, including, but not limited to, unit startups. (0.75)

REFERENCE
Millstone OP-302, rev. 15, pg 3, 5 & 46 FJC 104

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 7.04 (3.00)

a. Prerequisite Chechoffs:
   1. Pre-critical Sys. Status Checkoff OR (OPS Form 201-3) (0.33)
   2. Pre-critical checkoff OR (OPS Form 201-1) (0.33)
   3. Panel 905 Pre-critical Checkoff OR (OPS Form 201-2) (0.34)

b. The Station Superintendent or, (0.33)
   Unit Superintendent (0.33)
   Operations Supervisor (0.34)

c. Record the time, period, rod, group, notch, Rx water temperature and the critical number in the SS Log. (1.00)

REFERENCE
Millstone OP-201, Rev.13, pg. 2 & 5 and ACP 6.01 Rev. 13, sect. 6.1.2
FJC 105

ANSWER 7.05 (1.50)

a. Reactor power operation above 5 % thermal power causes significant amounts of Hydrogen and Oxygen in the main condenser. (0.50) Operation of the Mechanical Vacuum Pump under these conditions could result in a detonable concentration of hydrogen and oxygen at atmospheric pressure in the pump or its associated water separator. (Personnel and Equipment hazzard). (1.00)

REFERENCE
Millstone OP. # 202, Rev. 13, pg. 7. FJC 108

ANSWER 7.06 (3.00)

a. Maintain level > +50 inches to enhance natural circulation and thus prevent thermal stratification and heatup/pressurization. (1.00)

b. (The operator must assume that thermal stratification, heatup, and pressurization may occur). Primary and secondary containment must be maintained and tech specs for above 212 F operation must not be violated. Personnel working on primary components must be advised of possible pressurization. Monitor vessel parameters for prompt indication of heatup. Run shutdown cooling in max. flow, 2 pumps. (2.00)

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

REFERENCE
OP-206, Rev. 8, pg. 4. FJC 114

ANSWER 7.07 (1.75)

Check that the reactor scrammed on its primary source signal by reviewing the printouts of the sequence of events typer, the computer typers, and the charts of applicable recorded parameters. (1.75)

REFERENCE
OP-207, Rev. 9, pg. 3. FJC 115

ANSWER 7.08 (1.50)

a. 75 F +,-, 10 F (0.50)
b. If it necessary to cover heat exchanger tubes (when three heat exchangers are needed for plant cooldown) (1.00)

REFERENCE
OP-309C, Rev. 6, pg. 3. FJC 116

ANSWER 7.09 (2.00)

This action prevents the steam tunnel isolation dampers from opening while the SBGT system is operating. Opening of the steam tunnel isolation dampers during SBGT operation would allow a path for a potential uncontrolled radioactive release. (2.00)

REFERENCE
OP-329, Rev. 11, pg. 6. FJC 117

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 7.10 (1.50)

a. General Emergency (0.25)
b. Alert (0.25)
c. None required however candidate may elect to classify as an unusual event. (0.25)
d. General Emergency (0.25)
e. Site Area Emergency or alert since f.h. accident not stated (0.25)
f. None required. (0.25)

REFERENCE
Millstone EAL's Rev.1 FJC 130

ANSWER 7.11 (1.25)

1. Verify Reactor Scram. (0.25)
2. Close all MSIV's from CRP 903 and place the Isolation Condenser in service. (0.50)
3. After automatic start of diesel generator and/or G.T.G., start one RBCCW pump and one CRD pump. (0.50)

REFERENCE
Millstone ONP 503B Rev. 1 pg. 1. FJC 131

ANSWER 7.12 (1.50)

a. SS- shutdown communications area by make demineralizer. (0.25)
SCO- Main steam line 825# pressure switches. (0.25)
b. By isolating and venting scram air header low pressure pressure switches on rack 2251 (0.50)
c. Check all scram valves open. (0.50)

REFERENCE
Millstone ONP 511 Rev. 1. ppg. 1-3 FJC 133

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 8.01 (2.25)

a. All equipment is out of service (for maintenance) and not required by Technical Specifications for the existing mode of operation. (1.00)

b. Prior to proceeding to the operating mode,according to Tech. Spec.s, requiring operability of the Vital equipment.(0.50) A plant operator and a security rep. must inspect the area for explosives and/or abnormal conditions.(0.50) Update the Shift Supv. and Security Logs as to the time/date and results of the inspection. (0.25)

REFERENCE
Admin. Procedure ACP. 7.05 Access Control. FJC 109

ANSWER 8.02 (3.00)

a. Yes . A system or component can be assumed operable if the associated surveillance requirements have been satisfactorily performed within the specified time interval, the system is not having maintenance being performed and is in an operable status. (1.00)

b. 1. Any hour of the day plus or minus six hours, not less than once/day.
2. The scheduled date plus or minus one week, not less than 12/year.
3. The scheduled date plus or minus three wks., not less than 4/year.
(0.33 for each correct answer)

c. An extension not to exceed 25 % of the test interval and a total maximum combined interval time for any three (3) consecutive tests not to exceed 3.25 times the test interval. (1.00)

REFERENCE
Millstone ACP.-QA-9.02-Station Surveillance Program . FJC 111

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 8.03 (3.00)

a. This was provided to give protection against fast reactor depressurization and the resulting rapid cooldown of the vessel.[1.0] or provide protection from Bypass valves or control valves opening on pressure regulator failure
b. It prevents high power operation at low reactor pressure from occuring,[1.0] thus providing protection for the fuel cladding safety limit.[1.0]

REFERENCE
Millstone T/S Bases 2.1.2.G & H FJC 118

ANSWER 8.04 (1.25)

The SRO is required to be present as this is classified as an ALTERATION of the Rx Core. (1.25)

REFERENCE
Millstone T/S Def. ALT of Rx Core FJC 119

ANSWER 8.05 (3.00)

The LCO. for the S.G.T.S in this condition as stated in Tech. Spec. sec. 3.7.b.3 and 3.7.b.4. allows for refueling operations to continue for a period of seven (7) days provided that during such seven days,all active components of the other S.G.T.S. train (and associated circuitry), be operable. (1.50)
In addition there shall be operable either,
a. two sources of outside power (two 345kv or one 27.6kv and one 345kv) and one emergency power source , OR
b. one source of outside power and two (2) emergency power sources, for operation of the components in the operable S.G.T.S.train.(1.50)

REFERENCE
Technical Specifications Sec. 3.7.B.3 and 3.7.B.4. FJC 120

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 8.06 (2.00)

Yes. As per T.S. 4.6.G.1, operation may continue since it can be assumed that indicated recirculation pump flow-to-speed mismatch is less than 10%, both indications of T.S. 4.6.G.1.a and b must be seen to declare a jet pump inoperable.
If candidate ASSUMES indication of recirc pump flow-to-speed mismatch then plant must be in cold shutdown in 24 hrs. per T.S. 3.6.G.1. (2.00)

REFERENCE
Millstone T.S. 3.6.G. and 4.6.G. FJC 121

ANSWER 8.07 (2.50)

a. 2 SOL's one dedicated to supervision of core alterations
   1 OL
   1 Non-licensed operator (1.25)
b. 2 SOL's
   2 OL
   2 NLO
   1 STA (1.25)

REFERENCE
Millstone T.S. table 6.2.1. FJC 122

ANSWER 8.08 (1.25)

a. True (0.25)
b. True (0.25)
c. True (0.25)
d. True (0.25)
e. False (0.25)

REFERENCE
Millstone ACP 2.06A, Rev. 8 FJC 123

ANSWERS -- MILLSTONE 1 -85/08/13-CRESCENZO, F.

ANSWER 8.09 (2.00)

a. Shutdown in 4 days per T.S. 3.5.B.5 (1.00)
b. Shutdown in 24 hrs. per T.S. 3.5.B.6 (1.00)

REFERENCE
Millstone T.S. 3.5.B.5,6 FJC 124

ANSWER 8.10 (1.00)

a,b (1.00)

REFERENCE
Millstone T.S. section 6.9 FJC 125

ANSWER 8.11 (3.00)

a. YES, a T/S violation has occurred.[0.5] A Safety Limit is assumed to have been exceeded if the scram is accomplished by a means other than the primary source signal.[1.0]

b. Ensure the reactor is in at least hot shutdown within two hours[0.5] notify the NRC Operations Center within one hour[0.5] and start preparation of a Safety Limit Violation Report.[0.5]

REFERENCE
Millstone T.S. 2.1.1.C AND 6.7 FJC 127

ANSWER 8.12 (.75)

Yes. A designated management representative will perform the functions of the STA. (0.75)

REFERENCE
Millstone EPIP Form 4102 Rev. 1 FJC 132

QUESTION	VALUE	REFERENCE
05.01	1.00	FJC0000067
05.02	3.00	FJC0000077
05.03	3.00	FJC0000078
05.04	2.50	FJC0000079
05.05	3.00	FJC0000080
05.06	2.00	FJC0000081
05.07	2.00	FJC0000082
05.08	3.00	FJC0000084
05.09	2.50	FJC0000085
05.10	3.00	FJC0000086
	25.00	
06.01	2.00	FJC0000087
06.02	3.00	FJC0000089
06.03	3.00	FJC0000090
06.04	2.00	FJC0000091
06.05	1.50	FJC0000092
06.06	2.50	FJC0000093
06.07	1.00	FJC0000094
06.08	3.00	FJC0000095
06.09	2.00	FJC0000099
06.10	1.00	FJC0000100
06.11	2.00	FJC0000101
06.12	2.00	FJC0000128
	25.00	
07.01	3.00	FJC0000040
07.02	2.00	FJC0000102
07.03	3.00	FJC0000104
07.04	3.00	FJC0000105
07.05	1.50	FJC0000108
07.06	3.00	FJC0000114
07.07	1.75	FJC0000115
07.08	1.50	FJC0000116
07.09	2.00	FJC0000117
07.10	1.50	FJC0000130
07.11	1.25	FJC0000131
07.12	1.50	FJC0000133
	25.00	
08.01	2.25	FJC0000109
08.02	3.00	FJC0000111
08.03	3.00	FJC0000118
08.04	1.25	FJC0000119
08.05	3.00	FJC0000120
08.06	2.00	FJC0000121
08.07	2.50	FJC0000122

QUESTION	VALUE	REFERENCE
08.08	1.25	FJC0000123
08.09	2.00	FJC0000124
08.10	1.00	FJC0000125
08.11	3.00	FJC0000127
08.12	.75	FJC0000132
	25.00	
	100.00	

ATTACHMENT 2

U.S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

Facility: Millstone 1
Reactor Type: Boiling Water Reactor
Date Administered: August 13, 1985
Examiner: Brian K. Hajek
Candidate: MASTER - FINAL

INSTRUCTIONS TO CANDIDATE:

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

Final Grade _____ %

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

_____
Candidate's Signature

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

1.1 OP 201, Startup to Criticality, states "When neutron count rate has doubled four (4) times, the reactor operator shall withdraw each rod in a group one notch and repeat this sequence until the group is at its designated position."

a. Until this point in the procedure, it was permissible to use notch override to withdraw control rods. When may notch override be used again with rod withdrawal? (0.5)

b. Explain the reason for requiring the single notch withdrawal method to be used. Include (1) the specific conditions that can cause difficulties if caution is not exercised, (2) how core position can affect the severity of the problem, and (3) what might occur if this caution is not observed. (2.0)

1.2 Core orificing is used to assure uniform flow through all fuel elements. Briefly explain how core orificing assures relatively uniform flow independent of plant operating conditions, and as a function of location in the core. (2.0)

announced →

1.3 Power level is being maintained on the IRMs to maintain a heatup rate of about 70 F/hr in accordance with OP 202, Plant Heatup. Step 5.5 requires the reactor head vents to be closed prior to reaching 200 F. As the reactor operator, you close the head vents at CRP 904, and note that the panel indications switch to indicate proper closure. However, a fault occurred at the valves, and the head vents have not closed. But you, believing the valves have closed, continue the heatup procedure. Considering

(1) reactor power and reactivity,
(2) water temperature,
(3) vessel pressure, and
(4) the resultant effect on the heatup rate,

briefly explain how the reactor system would respond to this malfunction, and what indications you would have that this fault had occurred. (3.0)

Category Continued on Next Page

1.4 The Standby Liquid Control System provides an alternative to control rods for shutting down the reactor from full power at any time in core life. What are five of the six positive reactivity effects that may need to be overcome by the injected solution? (2.5)

1.5 The Reactor Water Cleanup System continuously circulates water through Filter/Demineralizers to assure high water purity.

a. Give three reasons for maintaining the water purity. (1.5)

b. Why is any increase in the conductivity of the water at the outlet of the Filter/Demineralizers as indicated in the control room considered to be a serious condition? (1.0)

1.6 Moisture Separators are in the steam flow path between the high and low pressure turbines. Their primary purpose is to remove moisture from the steam to protect the turbine blades. They may also increase cycle efficiency. Briefly explain how the moisture separators may increase cycle efficiency. A figure may help with your explanation. (1.5)

1.7 The Rod Worth Minimizer is provided to protect against the consequences of a rod drop accident.

a. When is the RWM not required? (0.5)

b. Briefly explain from a reactor physics point of view why the RWM is not required in the power range you have indicated in Part a. Give at least two reasons. (2.0)

1.8 The Reactor Water Cleanup System uses two types of heat exchangers. These are known as the regenerative and the non-regenerative heat exchangers.

a. What is the primary difference between these two types of heat exchangers? (1.5)

b. What is the principle advantage of using a regenerative heat exchanger in the RWCU system? (1.0)

Category Continued on Next Page

1.9 During a reactor startup, the neutron count rate measured on the SRMs has increased to 500 cps at which point the Reactor Engineer states that Keff is 0.99. As the Reactor Operator, you withdraw eight control rods an additional two notches each. The count rate increases to 4000 cps. Is the reactor critical? Justify your answer with at least two arguments or methods. (2.5)

1.10 State how the channel quality will change (increase, decrease, or remain the same) for the following instantaneous parameter changes. Assume a position in the channel about three feet from the core top, and the reactor operating at 80 percent power.

a. Power increase (0.5)

b. Channel flow increase (0.5)

c. Decrease in inlet subcooling (0.5)

d. Pressure increase. (0.5)

1.11 The Doppler coefficient of reactivity is important in the limiting of transients during reactor operation.

a. Briefly describe what is meant by Doppler broadening. (0.5)

b. Why does the Doppler Defect continue to increase as fuel temperature increases while the Doppler Coefficient decreases as the fuel temperature increases? (1.0)

End of Category

2. PLANT DESIGN, INCLUDING SAFETY AND EMERGENCY SYSTEMS (25)

2.1 The Isolation Condenser is a standby, high-pressure system for removal of decay heat following a reactor a reactor isolation scram.

a. If the water level is normal at the time of IC automatic initiation, how much time do you have to provide makeup if 1-IC-10, the automatic fill valve, fails to open? That is, how long will the IC operate without shell makeup? (0.5)

b. What is the normal standby valve lineup? (1.5)

c. How does the valve lineup change when the IC automatically initiates? (1.0)

2.2 OP 206, Plant Cooldown to Cold Shutdown, requires that the Reactor Vessel Head Cooling System be placed in service to assist in even cooldown of the vessel. This system uses the backup Control Rod Drive pump to supply water to the spray nozzle. If the operating CRD pump fails (the pump that is supplying water to the CRD system) during a cooldown, can operation of the Head Cooling System continue? Explain your answer. (2.0)

2.3 The Instrument and Station Air Systems are crosstied to permit either system to be provided with air from the other system s compressor.

a. How is the Instrument Air system protected from a failure in the Station Air System that causes Station Air pressure to drop? Include the setpoint and the action that will occur. (1.0)

b. If Instrument Air pressure drops, at what pressures and what actions will occur to maintain Instrument Air pressure? (1.5)

Category Continued on Next Page

2.4 The Feedwater Coolant Injection System uses normal components of the Feedwater and Condensate Systems to provide emergency water to the vessel under small break conditions.

a. What signals will initiate FWCI? (1.0)

b. How does FWCI cause vessel depressurization? (0.5)

c. The Feedwater Regulating Valves operate in either Flow Control or Level Control modes. When FWCI is initiated after a loss of normal power (LNP), what mode will the FRVs be in when injection starts, and what will cause the FRVs to change between the two operating modes? (1.5)

2.5 The Vital AC Bus is designed to receive an "uninterruptible" supply of power. Power is available from three sources, two of which may be considered normal, and the third alternate.

a. Briefly describe how the Vital AC Bus receives power from these three sources. (1.5)

b. If the power source switches between the two normal supplies, no loads will be lost. However, if power switches to the alternate supply, some plant loads may be lost. Briefly explain why this occurs. (1.0)

2.6 Each Safety/Relief Valve Discharge Pipe has ~~three~~ two vacuum breakers installed.

a. What condition would cause the vacuum breakers to open? (0.5)

b. What two adverse effects could result if the vacuum breakers did not perform their intended function? (1.5)

Category Continued on Next Page

2.7 The Turbine Building Secondary Closed Cooling Water System includes two 100 percent capacity pumps and two 100 percent capacity heat exchangers.

a. Why must SCCW flow be directed through both heat exchangers? (1.0)

b. How is SCCW temperature controlled? (0.5)

c. The SCCW pump discharge pressure must be maintained greater than 90 psig. (1) Why is this necessary? (2) If the discharge header pressure falls below 90 psig, why should the second pump not be started? (3) What should be done to maintain pump discharge pressure? (1.5)

2.8 The Low Pressure Coolant Injection System includes two independent loops connected by a crosstie header. Explain the purpose of the crosstie line. What are the crosstie valve (1-LP-8A) positions during LPCI standby and operating conditions? (1.5)

2.9 The Reactor Recirculation System contains two separate loops. Each loop has either suction or return connections for several other plant systems. List these connections for each loop. State whether each connection is a suction or a return path. (2.5)

2.10 The Core Spray System pumps may receive power from more than one source. What are these power sources, and what will the start sequences be for the pumps if normal power is available, and if normal power is lost? Be sure to include the buses as well as the source of power to the buses. (3.0)

End of Category

3. INSTRUMENTS AND CONTROLS (25)

3.1 The 24 Volt D. C. Electrical System supplies power to the SRMs and other nuclear and process instruments.

a. Will SRM operation be affected if the 120 V.A.C. power is temporarily lost to the battery chargers? Why or why not? (1.0)

b. Upon receipt of the 24V Battery Charger 1A Trouble alarm, you determine that the voltage is zero. How can you determine whether the Battery Charger has shut down due to a low voltage or a high voltage condition? (1.0)

3.2 During a reactor startup, power has been temporarily leveled on Range 7 of the IRMs. If the Range Switch is not changed, at what reading will each of the following alarms occur if power drifts either up or down? Include the automatic protective action that will be initiated.

a. IRM DOWNSCALE (1.0)

b. IRM HIGH (1.0)

c. IRM HI-HI (1.0)

3.3 The Reactor Protection System receives signals from many plant systems to shut down the reactor when potentially unsafe conditions arise. One such event is the closure of the turbine stop valves.

a. What is the setpoint for receipt of a scram from stop valve closure? (0.5)

b. When is this scram function bypassed? (0.5)

c. With the reactor operating at 60 percent power, will partial closure of Stop Valves 1 and 4 result in a reactor scram? Explain your answer. (1.5)

Category Continued on Next Page

3.4 The Rod Block Monitor System is designed to prevent local fuel damage.

a. Why are the preset limits on local power a function of flow rate? (1.0)

b. Why is recirc loop flow used rather than core flow? (1.0)

3.5 Accumulators in the Hydraulic Control Units assure that the control rods will fully insert on receipt of a scram signal at any reactor pressure. Accumulator pressure normally floats at CRD pump discharge pressure.

a. What will happen to accumulator pressure if the running CRD pump trips? Why? (1.5)

b. After a reactor scram occurs, when the accumulators need to be recharged, what assures that the CRD pump does not go into runout? (0.5)

3.6 According to OP 336, Core Spray System, the "Core Spray Header A (B) Hi Dif Pressure" alarm windows are normally in an alarmed state at cold shutdown or as cold conditions are approached as the reactor is being shutdown.

a. During normal reactor at power operations, what is indicated if one of these windows alarms? (1.0)

b. Why are the windows normally showing alarmed status when the reactor is cold? (1.0)

3.7 An Anticipated Transient Without Scram System provides a redundant safety grade control capability.

a. What two actions are taken by this system to assure insertion of negative reactivity? (1.0)

b. What conditions will initiate the actions listed in Part a ? Include any time delays involved, and the combinations of these conditions that are necessary. (2.0)

Category Continued on Next Page

3.8 The reactor has been operating at 80 percent power for three days about three months into core life. The Master Controller has failed high, and so each loop is being operated in Loop Manual Control. Explain what will happen to the recirculation pump speed for each of the following independent, separate, and unrelated events.

a. The Discharge Valve in the A Loop begins to slowly drift closed. The drifting stops at about a 70 percent open position. (1.0)

b. The reactor operator inadvertently switches the A Loop M/A Transfer Station to Auto. (1.0)

c. The Speed Controller output from the A Loop Controller fails to zero. (1.0)

3.9 The reactor power level has been stabilized at about 80 percent. The Level Master Control Station is in Manual, and it is desired to switch to Automatic. Manual operation has not stabilized with the deviation pointer nulled. Briefly outline two methods for nulling the pointer before switching to auto and stabilizing the water level. (2.5)

3.10 The Turbine Control System contains a pressure control unit that consists of two independent pressure regulators and a bypass valve opening jack.

a. With the reactor operating at full power, why is it preferable to control with the EPR rather than the MPR? (1.0)

b. You are directed to switch operation to the MPR so maintenance can be done on the EPR. (1) As you adjust the MPR to take control, will its servo position increase or decrease? (2) What will the final servo position be for the EPR after the MPR has taken control? (1.0)

c. Why shouldn't the bypass valve opening jack be operated while the turbine is on line? Where is it positioned during normal plant operation, and what could happen if it is taken from this position? (1.0)

End of Category

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (25)

4.1 The Pre-Critical Checkoff, OPS Form 201-1, requires the Control Operator to verify in Step 19 that power sources are available and buses are energized in accordance with Tech Spec 3.9.A. What are the five conditions that must be satisfied? (2.5)

4.2 You have been dispatched to the Reactor Feedpump area to investigate a decreasing lube oil pressure condition. Upon arrival, you discover a small oil leak, and a fire. According to ONP 505, Fire, what are your immediate reporting and action requirements? (2.5)

4.3 Large motors may overheat if excessive starts are attempted in too short a period of time. According to OP 301, Nuclear Steam Supply System, what are the limitations for repeated starts of the Reactor Recirculation System M. G. Set Drive Motors with the motor either hot or cold? (2.0)

4.4 According to ONP 507, Loss of Vacuum, if a low vacuum alarm is received at 25 " Hg, you are to attempt to stabilize the vacuum by correcting the cause. Checking the recorder, you note that vacuum has been decreasing at a rate of about one inch per hour.

a. How much time do you have to find and correct the cause of the decrease in vacuum before a reactor scram may occur? (0.5)

b. If after some time of investigation, you have not been able to determine the cause, and vacuum is continuing to decrease, what specific action could you take to slow down the rate of change of vacuum? (0.5)

c. If vacuum continues to decrease, and the reactor scrams, how long can the main condenser be used as a heat sink? (0.5)

Category Continued on Next Page

4.5 It is 6:40 a.m., and your shift is scheduled to start at 7:00 a.m. A small leak has occurred that has not yet been identified, and reactor water level is falling. The reactor has shut down and the EOPs have just been entered. According to ACP 6.12, Shift Relief Procedure, if all members of your shift crew have arrived in the Control Room, can the shift turnover process begin? Why or why not? (1.5)

4.6 What are the five entry conditions for the three Reactor Pressure Vessel Control procedures, EOPs 570, 571, and 572? (2.5)

4.7 Water in the Reactor Building Closed Cooling Water System is cooled by the Service Water System in three heat exchangers. OP 309C, Reactor Building Closed Cooling Water System, contains several precautions and requirements concerning the interaction of these two water systems.

a. The RBCCW heat exchanger outlet temperature is normally controlled by manipulating the heat exchanger bypass butterfly valve, and not the Service Water outlet butterflies, but there is one significant exception to this caution. Under what conditions may the Service Water butterfly valves be throttled? (1.0)

b. When the RBCCW System is being placed in service, should the RBCCW side of the heat exchangers be cut in first, or should the Service Water side be cut in first? Why? What about when the heat exchangers are secured? (1.5)

4.8 According to ONP 515B, High Conductivity After Condensate Demineralizers,

a. What five indications (recorder readings and/or alarms) could you have that a failure to clean the water was occurring? (1.5)

b. If these indications were verified, what five immediate actions are required? (1.5)

Category Continued on Next Page

4.9 According to OP 350, Stack Gas Monitoring System,

a. What recorders should be checked as part of the immediate operator actions to confirm a high or high high alarm condition? (1.5)

b. What concurrent alarm condition would lead to a reduction in reactor power to reduce radiation levels in the stack gas? (0.5)

4.10 You are operator in the Control Room when a leak occurs in the Reactor Clean-Up System. According to ONP 516,

a. What indications would you have of this event in the Control Room? (1.5)

b. What immediate actions would you be required to take? (1.0)

4.11 Condenser vacuum is established initially by use of a mechanical vacuum pump which, according to OP 324A, Condenser Air Removal System, may be used only at low reactor power.

a. By what power level must the mechanical vacuum pump be taken off line? (0.25)

b. Why can't the mechanical vacuum pump ~~must~~ be used above this power level? (1.0)

c. When the mechanical vacuum pump is taken out of service, what action is required, including the action inside CRP 907, to assure the safety of the pump? (0.75)

d. If the reactor was above this power level, how could you test the mechanical vacuum pump? (0.5)

End of Examination

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$\Delta E = 931\ \Delta m$

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

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

$Pwr = W_f\Delta n$

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

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

$SUR = 26.06/T$

$SUR = 25\rho/\ell^* + (\beta - \rho)T$

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

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

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

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

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

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

$\Sigma = \sigma N$

$v = s/t$

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

$a = (V_f - V_o)/t$

$w = \theta/t$

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

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

$\lambda = \ell n 2/t_{1/2} = 0.693/t_{1/2}$

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

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

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

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

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

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

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

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

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

$\bar{\lambda} = 0.1$ 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)

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.

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. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER, AND FLUID FLOW (25) - ANSWERS

1.1 a. Notch override may not be used again until the point of adding heat is achieved. [This seems to be above 100 % on Range 6.]

b. (1) For startups following a reactor shutdown, either a planned shutdown or a reactor scram, conditions of high Xenon will exist. (0.5)

(2) Xenon will be higher in areas of the core where the flux was highest. This will tend to depress the flux in these areas and cause the flux in areas of the core where the flux was previously low to be higher. This will cause the reactivity of the control rods to increase in the previously low flux regions. In particular, rods in the periphery of the core, and near the top, will tend to have higher reactivity worths. (1.0)

(3) If caution is not observed, a short period may result [leading to an IRM scram]. (0.5)

REFERENCE: OP 201, Precaution 4.6, Steps 5.2 and 5.5, Reactor Theory Manual, 6-11 - 6-12.

1.2 (1) Two regions are used for core orificing. The central region consists of all but the outermost ring of perimeter fuel. The outer region has smaller or fewer orifices.

(2) The orifices add a relatively large dP to the total dP across the core. The dP added by boiling is then insignificant compared to the dP of the orifices, and so the dP is nearly the same (as is flow) to all fuel cells under any condition of power.

REFERENCE: Thermo & Fluid Flow, ppg. 12-21 - 12-22, Lesson Plan, Reactor Pressure Vessel and Internals, ppg. 29 - 30, Figures 15 and 17.

Category Continued on Next Page

1.3 (2) As the heatup continued, the water temperature would begin to steady out at the saturation temperature for the vented system. This will be higher than 212 F since it will track the vessel pressure. (0.75)

(3) Vessel pressure will continue to increase, but will be maintained slightly above atmospheric due to the backpressure from the vent lines. (0.75)

(4) Since the pressure is not increasing, and the temperature increase has been slowed, the heatup rate will decrease. (0.5)

(1) Reactor power will be maintained by the operator and should stay at steady state, However, since the temperature is not increasing at the earlier rate (70 F), control rods will not need to be withdrawn as much to compensate for the moderator coefficient of reactivity. As more boiling occurs, however, more negative reactivity will occur. (1.0)

REFERENCE: Thermo & Fluid Flow, ppg. 1-23f.,
Reactor Theory, ppg. 4-8f.

1.4 (1) Elimination of steam voids
(2) Moderator temperature shift from hot to 125 F
(3) Reduced Doppler effect
(4) Decreased control rod worth as moderator cools (boron in competition with control rods)
(5) Xenon decay
(6) Shutdown margin of 2.6 %

0.5 for each of any five.

REFERENCE: LP # 1304, pg. 7.

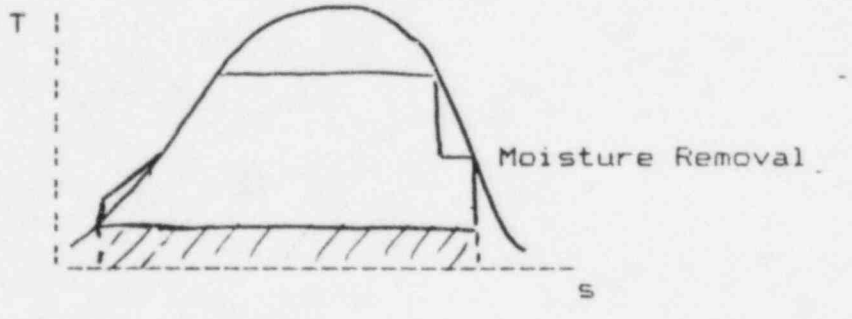
Category Continued on Next Page

1.5 a. (1) Reduce damage to components due to chemical and corrosive attack.
(2) Reduce fouling of heat transfer surfaces and mechanical parts.
(3) Reduce impurities available in the water for activation by neutron flux.
(4) Maintain clarity for fuel handling (Not in Lesson Plans, but acceptable answer.).

b. The demin beds operate with a low conductivity output for a long time. When the conductivity begins to increase, it increases very rapidly. The reason is that ions break through, and the first to break through are the worst for operation - namely the chlorides.

REFERENCE: LP # 1303, ppg. 13, 14 and 25.

1.6 Cycle efficiency may be increased as shown on a T-s diagram by extending the turbine's ability to remove energy from the steam. By removing moisture from the steam, the mixture becomes dryer, and the line moves closer to the saturation line at constant temperature. This enables the turbine to operate with additional stages, and thus reduces the turbine exit temperature. This causes the area under the T-s curve that is subtracted as waste energy to become smaller.



REFERENCE: Thermo & Fluid Flow, pg. 4-19 and Figure 4-11.

Category Continued on Next Page

1.7 a. The RWM is not required at power levels greater than 20 percent.

b. (1) At higher power levels, the voiding in the top of the core causes a flattening of the axial flux profile. This reduces the peak to average flux profile surrounding the control rod, and reduces the reactivity that would be inserted if the rod dropped.

(2) At higher powers with more control rods withdrawn from the core, the effect of the rod drop would be distributed over a larger core region, resulting in lower heat generation.

REFERENCE: LP # 1409, RWM, pg. 3.

1.8 a. The regenerative heat exchanger uses the same fluid for the cooling side as is used on the cooled side of the coils.

The non-regenerative heat exchanger uses a different fluid (RBCCW) from the cooled fluid.

b. The use of the regenerative heat exchanger reduces the heat loss from the plant because it returns heat back to the clean-up water.

REFERENCE: Thermo & Fluid Flow, pg. 5-3 and Figure 5-2.

Category Continued on Next Page

1.9 No. (0.5)

(1) If the count rate has leveled off, that is, it is not continuing to increase at a steady rate without additional control rod motion, the reactor is not critical.

(2) From the equation CR1/CR2 = (1 - K2)/(1 - K1), it can be shown that K2 = .99875.

or

Using the count rate doubling technique technique, the same result can be shown:

500	0.99
1000	0.995
2000	0.9975
4000	0.99875

REFERENCE: Reactor Theory text, ppg. 3-5 - 3-15.

1.10 a. ~~Decreases~~ Increase

b. Decreases

c. Increases - [Less power required to cause boiling]

d. Decreases - [Voids collapse]

REFERENCE: Thermo & Fluid Flow, ppg. 8-32 - 8-33, 8-58 Q #15.

Category Continued on Next Page

1.11 a. Doppler broadening is the broadening of the resonance peaks as temperature increases. This causes the probability of absorbing a neutron to increase.

b. As the temperature increases, the peaks broaden. As temperature continues to increase, the peaks don't broaden as much per unit change in temperature. This causes the Doppler coefficient to decrease as temperature increases. (0.75)

However, the Doppler defect is the total amount of reactivity inserted by the Doppler effect. It will always increase as fuel temperature increases, though at a slowing rate. (0.25)

REFERENCE: Reactor Theory, ppg. 4-33 - 4-40.

End of Category

2. PLANT DESIGN, INCLUDING SAFETY AND EMERGENCY SYSTEMS (25) - ANSWERS

2.1 a. 40 minutes

b. 1-IC-1, 2, 4, 6, and 7 are open.

1-IC-3 is closed.

c. 1-IC-3 opens, and -6 and -7 close.

REFERENCE: LP # 1307, IC, pg. 3, and OP 307.

2.2 Yes (0.5)

If the operating CRD pump fails, the backup pump must be used to supply the CRD system. However, the valves may be manually positioned to provide a reduced flow to the Head Spray System by reducing the cooling water header flow.

REFERENCE: OP 206, Step 5.11, OP 306, Steps 6.1 and 6.4.

2.3 a. On low pressure in the Station Air header, at 80 psig, the Station Air header isolates [by closing 1-SA-24].

b. (1) When Instrument Air pressure drops to 93 psig, Station Air is supplied to Instrument Air [through 1-SA-21].

(2) If Instrument Air is supplying Station Air, and SA pressure drops to 80 psig, the SA header will isolate [by closing 1-SA-24]. 0.75

(3) If IA is supplying SA, and IA Receiver pressure drops to 90 psig, air flow to SA will cease [by closing 1-IA-18]. 0.75

Does not happen any more because ~~a~~ valve has failed (any even have been removed) - is locked open.

REFERENCE: LP # 1333, pg 5, and Figure 1.

b. (1) @ 90 psig in IA Receiver SA compressor starts

Category Continued on Next Page

(2) @ 90 psig in IA Receiver, (IA-18) v/v supply IA to SA closes

(3) @ 85 psig in IA header, SA compressor starts

Ref: LP 1333A, pg 3-5, LP 1333 B, pg 7 and Figure 1

2.4 a. High Drywell pressure (2.0 psig)
and/or
LoLo Reactor water level (-48 inches)

b. By injection of cold water (not heated by extraction steam) from the Hotwell.

c. The FRVs will be in Level Control [when the feed pump discharge pressure reaches 300 psig] and injection first starts. (0.5)
If the flow reaches 105 percent, the FRVs will switch to Flow control [to prevent pump runout] until the level returns to 37 inches, (0.25) (0.25)
~~The FRVs will remain in level control as long as the flow remains below 105 percent.~~ ~~(0.5)~~

Sw. from Flow to level control
1. When level ≥ 37"
2. Op. pushes both reset
3. Pump discharge Pressure ≥ 300 psig

or 4 resets (.25)

0.25

REFERENCE: LP # 1334, ppg. 5, 10, and 11.
LP # 1316, ppg. 19-22

2.5 a. The first source of power is normal AC [from MCC-E5] to the AC powered generator drive motor. (0.5)
If the normal AC is lost, an automatic transfer to the DC supply [from 101 AB-3] occurs. This provides power to the generator DC drive motor. (0.5)
If both normal supplies are unavailable, an automatic transfer occurs to the alternate supply [IV-1 from MCC-F5]. (0.5)

b. Both auto transfers are break before make. (0.2)

The transfer between the two normal supplies will take place without loss of loads because of the flywheel maintaining voltage during the transfer. (0.8)

REFERENCE: LP # 1343, ppg. 2 - 3, and Figure 1.

2.6 a. Underpressure in the lines.

b. (1) A water slug would be drawn up into the line, and when a valve operation occurred, the slug would be driven into the suppression pool, causing excess stresses. (1.0)
(2) Underpressure in the pipe would affect the relief valve setpoint. (0.5)

REFERENCE: LP # 1337, pg. 7.

Category Continued on Next Page

2.7 a. The maximum flow through each heat exchanger should be kept below 900 gpm.* The pumps will each deliver 1800 psig.

It doesn't really have to be and isn't manually because get low pressure alarm if run on two. Also, often 1 Hx is under repair.

b. By use of a heat exchanger bypass valve.

c. (1) To prevent pump runout. (0.5)

(2) Excessive system flows will result* cause relief on Hx shell side will lift & cause inventory loss & may not reseat.

0.5 for either part

(3) Throttle the system loads. (0.5)

REFERENCE: OP 309B, Sections 6.3 - 6.5, and LP # 1309, ppg. 17 ~~17~~

2.8 The crosstie line provides for the injection from all four LPCI pumps into either Recirc line. The loop selection logic will determine which loop may be broken, and will direct LPCI flow from the LPCI system normally injecting into the broken loop into the other loop through the crosstie line. (1.0)

1.0

not required

The crosstie valve is open during standby and operation. (0.5)

REFERENCE: LP # 1335, ppg. 6 - 22.

2.9

System	Loop A	Loop B	
LPCI	Return	Return	(0.5)
RWCU	Suction		(0.5)
S/D Cooling	Suction	Return	(0.5)
Sample System	Suction		(0.5)
Iso Cond		Return	(0.5)

REFERENCE: LP # 1301A, pg. 20 and Figure 2.

Category Continued on Next Page

2.10 (1)

Pump	Bus	Normal Supply	LNP Supply	
A	14F	NSST*	DG	(0.75)
B	14E	NSST*	GT**	(0.75)

*On a reactor trip, the power source will auto transfer from the NSST to the RSST. Either answer is acceptable.

**[Through a tie breaker from 14C.]

(2) If normal power is available from either the NSST or the RSST, the two pumps will start simultaneously. (0.5)
On an LNP, the B pump will start immediately, and the A pump will start with a 10 second time delay. (1.0)

REFERENCE: LP # 1336, pg. 7, and LP # 1340/1341, ppg. 5 - 6, and Figures 1 and 2.

End of Category

3. INSTRUMENTS AND CONTROLS (25) - ANSWERS

3.1 a. The channel will not be lost until the associated battery is sufficiently discharged. If the charger is returned to service in time, there will be no effect on SRM operation.

b. An operator will need to check all breakers and fuses. If they are all normal, then the charger has tripped on a high voltage condition [at 32 volts].

REFERENCE: LP # 1344, pg. 1, and OP 344B, pg. 8.

3.2 a. (3/125) * 40 = 0.96 (or 1)

Rod Block

b. (108/125) * 40 = 34.56

Rod Block

c. (120/125) * 40 = 38.40

Scram

REFERENCE: LP # 1402, pg. 15.

3.3 a. Less than or equal to 10 percent full open

b. This scram is bypassed at less than 45 percent power as sensed by turbine first stage pressure.

c. No. (0.5)

The trip system is designed so that closure of any two valves will not result in a scram. Any third valve closing will then cause a scram. This particular combination will not result in even a half scram (combinations of valve numbers that add up to five). Other combinations will give a half scram. [Note: This trip logic is the same as for the MSIVs.]

REFERENCE: LP # 1408, ppg. 13 - 15, Figure 4.

Category Continued on Next Page

3.4 a. Because thermal limits (MCPR) are based on the ability of the coolant to remove heat.

b. Because recirc loop flow has less short term variation and therefore produces more stable trip levels.

REFERENCE: LP # 1410, pg. 2.

3.5 a. The pressure will stay constant for a while, then slowly leak off through seals, and the check valve. A check valve in the charging water line will maintain the pressure in the accumulators. .75

b. A restricting orifice in the charging water line. .75

REFERENCE: LP # 1302B, ppg. 14 - 15.

3.6 a. The alarm indicates a possible loss of integrity of the header between the shroud and vessel wall.

b. The dP sensors are calibrated for hot conditions. Sensed pressure will decrease with decreased temperature of the reactor. [Normal reading is 4 psid, and the alarm point is 2 psid.]

REFERENCE: OP 336, Section 8.3 and 8.4, LP # 1336, ppg. 10 - 11, and Figure 6.

3.7 a. (1) Vents the scram valve pilot air header through two redundant ARI valves.
(2) Trips the recirc pump MG Set field breakers.

b. (1) Hi reactor pressure [1150 psig] (0.25)
(2) LoLo water level [-48 "] with a 9 sec TD (0.5)
(3) Manual (0.25)

Each Division (1 and 2) has two subdivisions. Either Division can cause ARI/RPT initiation if any one of the above, or combination of the above, is sensed in each of its subdivisions. (1.0)

REFERENCE: LP # 1408, Appendix A, and Figure B-1.

Category Continued on Next Page

3.8 a. ~~The pump speed will go to 28 percent as required by the limiter.~~ The pump trips if the discharge valve is not full open any time 4 min after a start. -LP B01B #13

b. The pump speed will go to the high speed setting of the Master Controller Speed Limiter - 102.5 % of rated speed (or 102.5 % of rated core flow with rated speed being 92 % to produce 100 % core flow with both pumps running).

c. The pump speed will stay the same as the Signal Failure Detector produces a scoop tube lockup.

REFERENCE: LP # 1301B, ppg. 8, 9, and Figure 4.

3.9 (1) With the Master Controller in manual, raise the reactor water level with the manual pot until the deviation meter is nulled. Then switch to auto.

(2) With the controller in manual, change the set point to null the deviation meter. Then switch to auto, and return the set point to the desired setting.

REFERENCE: OP 316, Section 7.4.

3.10 a. The MPR works as a backup to the EPR. With the MPR in control, there is no backup controller should the MPR fail.

b. (1) The MPR servo position will increase to match that of the EPR.

(2) The EPR servo position will slowly decrease to zero.

c. The BPV opening jack can override the pressure regulators and open the control and/or bypass valves further than the MPR or EPR calls for. This will lead to a pressure decrease, and a possible scram at 825 psig. For this reason, the jack should be placed at its lowest position during normal reactor operation.

REFERENCE: LP # 1314B, ppg. 2 - 3, and OP 314, Sections 7.8.4 and 7.8.6.

End of Category

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (25) - ANSWERS

4.1 1. One 345 kv line and associated equipment capable of supplying aux. power.
2. Both emergency power sources operable.
3. An additional source capable of supplying power to the emergency buses. [Either
a. 27.6 kv line, switchgear, and transformer
b. One 345 kv line.] = E & F
4. 4160 buses 5 and 6 energized [and the associated 480 buses energized.]
5. All [station and switchyard 24 and 125 volt] batteries and associated battery chargers are operable.

REFERENCE: OP 201, Form 201-1, Station Procedure or Form Change, 201-1, Rev. 8, Change 1, and TS Section 3.9.A.

4.2 (1) Report to the control room (0.3)
a. location (0.3)
b. type of fire (0.3)
c. size of fire (0.3)
d. components affected. (0.3)
(2) Ensure there are no injured personnel. (0.5)
(3) Fight the fire if a qualified fire fighter. (0.5)

REFERENCE: ONP 505/AOP 2559, pg. 1.

4.3 With the motor cold, two consecutive starts are allowed.(1.5) Following the second start, the motor must run for at least 30 min(5) or must be idle for at least 60 min(0.5) before another start is attempted. ~~(1.0)~~

With the motor hot, do not attempt more than one start.(0.5) Then same as above. ~~(1.0)~~

REFERENCE: OP 301, Step 6.11 as revised sometime between 12-2-82 and 1-17-85. Old procedure and lesson plan still show old values.

4.4 a. About two hours until 23 " Hg is reached
b. Decrease reactor power [Note: May need to consider other items listed in subsequent actions. Did not ask for immediate action
c. Until 7 " Hg is reached.

REFERENCE: ONP 507, ppg. 1 - 3.

Category Continued on Next Page

4.5 No. (0.5)

ACP 6.12 states "The plant shall be in a controlled condition at the beginning of the shift turnover process." (1.0)
OR YES if justify as a controlled condition
REFERENCE: ACP 6.12, Section 6.5.

4.6 (1) RPV water level less than +8 '.
(2) RPV pressure greater than 1085 psig.
(3) Drywell pressure greater than 2.0 psig.
(4) An isolation condition exists which requires or initiates a reactor scram.
(5) A condition which requires a reactor scram and reactor power is above 3 percent or cannot be determined.

REFERENCE: EOP 569, pg. 3.

4.7 a. [When three heat exchangers are needed during plant cooldown,] it may be necessary to throttle the Service Water outlet butterfly valves to cover the heat exchanger tubes.

b. (1) Establish the RBCCW flow before cutting in the Service Water.
(2) When securing the RBCCW, secure the Service Water side first.
(3) This is preferred to minimize any leakage from the salt water side to the RBCCW and its loads.

REFERENCE: OP 309C, ppg. 3 and 6.

4.8 a. Increasing conductivity would be indicated on
(1) Cond. Booster Pump discharge recorders [on 905 and 931]
(2) Feedwater Conductivity recorders [on 931]
Alarms that might be received are
(1) Booster Pump dischg cond. hi [0.2] [on 908]
(2) Booster Pump dischg cond. hi hi [.5]
(3) Feedwater High Conductivity [0.2 umho on 907]

b. (1) Scram the reactor
(2) Close hotwell reject to the CST [1-CN-67 and 69]
(3) Trip all operating reactor feed pumps
(4) Close FW Blocking valves [4A, B, & C]
(5) Close MSIVs and place the Iso Cond in service.

REFERENCE: ONP 515B, ppg. 1 - 2.

Category Continued on Next Page

4.9 a. (1) Stack gas radiation recorder
(2) Off Gas recorder
(3) Flux tilt recorder

b. High Off Gas

REFERENCE: OP 350, pg. 6.

4.10 a. (1) Erratic pressure control
(2) Erratic flow control
(3) Clean-up Recirc pump trip on low suction pressure [10 psig]
(4) Non-regen heat exchanger high temperature alarm
(5) High area temperature

b. (1) Isolate the leak
(2) Scram the reactor if the leak cannot be isolated.

REFERENCE: ONP 516, ppg. 1 - 2.

4.11 a. Do not use above 5 percent power.

b. There are significant amounts of hydrogen and oxygen present in the main condenser. Operation could result in combustion in the pump.

c. The suction valve must be closed, and the Mechanical Vacuum Pump Override Switch inside CRP 907 must be placed into the OVERRIDE position. [In this position, the valve will not operate.] (0.25) (0.5)

d. It may be test run with the suction valve closed.

These are part of a normal procedure and will be graded liberally.

REFERENCE: OP 324A, pg. 5.

End of Examination

Attachment 3

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

MEMO

August 15,1985
MP-S-T-755-85

TO: Frank Crescenzo

Michael C. Jensen

FROM: Michael C. Jensen
Training Supervisor
Millstone Unit 1

SUBJECT: Comments on NRC RO and SRO Examination (Written) Administered August 13, 1985.

Please find attached comments on the written exams by question numbers. Questions that do not appear on the comment sheet have no comments.

All comments are not nesessarily points of issue, some are other plausible answers.

MCJ/gls

cc: R. Z. Test
R. J. Palmieri
J. P. Stetz

1.1 b (comment only)
Operator will assume "cold, clean startup" by the stem of the question refering to OP-201 which covers the most complicated start-up. (i.e. cold, clean startup)

1.1 b (1) Conditions resulting in high rod worth: Xe, Mod.Temp., Control Rod pattern, Control Rod location, etc.

(2) Must know there is a significant Xe problem, which is not clear in the stem of the question.

1.2 (resolved)
Only need part (2) of answer key for full credit.

1.3 (resolved)
Answer key does not line up with question part numbers.

(1) Reactor power - you would start to continously boil at 212 F but you could overcome this by pulling more rods and continue with startup and heatup.

(2) Water temperature will increase to 212 F, then you could continue to increase temperature with rod withdrawl.

(3) Preasure would follow temperature as in part (2).

(4) H/U rate can be maintained Note: CRP-904 RMS operate head vent line are 1" valves to drywell equipment drain sump. First indication may be higher than normal sump pump operation.

1.6 (resolved)
Moisture Seperators in our plant do not increase our plant efficiency,they and only preclude turbine bucket damage.

1.10 (Resolved)
a. As power increases by Control Rod withdrawal, quality increases.

1.11 (Comment)
We don't use the word Defect in our discussion of Doppler Coefficient or Reactivity.

2.3 (resolved)
1-SA-21 no longer has any automatic feature. Valve is failed open and tagged in that position.

2.4 (resolved)
C. Conditions that cause FRV's to shift from flow control to level control

1) Rx Vessel level greater than or equal to +37".
2) Manual pushbutton depressed and held down
3) Feedpump discharge pressure drops to less than 300 psig.

The last response in answer key (0.5 pts) is a repeat of statement (0.25) regarding FRV's remaining in Flow Control as long as feedflow remains less than 105%.

2.7 (resolved)
C (2) Possible lifting of relief could also occur, with the potentional loss of inventory within the system and pump cavitation.

2.8 (resolved)
First sentence in answer key answers first question asked. Last sentence in answer key answers 2nd question asked. The 2nd sentence should not be required. Doesn't answer any question asked.

3.6 (Comment)
b. License canidates taught that reduction in core flow would cause the d/p alarm to be recieved, not reduction in moderator temperature.

3.8 (resolved)

a. The Recirc Mg Set drive motor breaker will trip if discharge valve leaves it open seat (provided 4 minutes has passed since the start signal.

4.4 (resolved)

Only action to reduce vacuum decrease that was accepted was to reduce reactor power (Immediate Action). Supplemental action steps also give actions to take to attempt to restore vacuum decrease.

4.5 (resolved)

Question asks for interpertation of the definition of "Controlled Condition." The answer key should accept either yes or no provided the canidates justifies the plant being or not being in a "Controlled Condition."

4.7 (Comment)

a. Requiring memorization of specific precautions in operating procedures.

4.11 (resolved)

parts C,D - Question requires memorization of operating procedures.

SRO Comments

5.03 (resolved)

Equation as part of answer vice word answer.

5.07 (Comment)

Plant indicationa would be MWe increase, MWth increase causing cycle effiency to decrease.

5.08 (resolved)
b. We don't teach operators which Flow Control System (throttle valve or pump speed) is more efficient, that is a design engineering consideration
W pump = UxPV
efficiency could be: Thermodynamic, Operational, Design, Piping, etc.

6.02 (resolved)
b. Pressing Flow Control reset button will <u>force</u> a reset to level Control, setting up a condition to cause pump runout.
c. 43 Seconds is not required information.

6.04 (resolved)
Transfer to self-excitation occurs at 10 seconds, not at 8 seconds.

6.06 (resolved)
Question asks "Could valve be throttled with isolation signal present? Why or Why not? "

Answer key requires, "No , valve will not throttle with isolation or <u>Initiation signal</u> present".

Question only asks if valve could be throttled with Isolation signal, does not ask if valve could be throttled with Initiation signal.

6.11 (resolved)
Indication of A and B as incorrect is not required.

7.01 (resolved)
a. Using delta Thc of 8°F minimum level is closer to 12 feet.

7.03 (resolved)

a. OP-302 7.15.4.2 and 8.19.4 both provide guidance to operator for action to take following continued rod out motion

7.08 (resolved)

b. Service water outlet valves are normally throttled - not just when 3 heat exchangers are needed for cooldown.

7.10 (resolved)

e. Could be alert because question doesn't state "Direct Observation of a Fuel Handling Accident."

8.03 (resolved)

a. Correct answer is also "provided protection against pressure regulator malfunction which could cause control and/or bypass valves to open".

8.05 (resolved)

Power Source requirements were in effect before LCO for SGTS resulting from failure. Question asks "Continue under what Conditions." Power requirements assumed met prior to SGTS Inop and therefore, not required.

8.08 (resolved)

b. ACP.206 allows "Mechanical or Electrical equipment for Blue tags."

e. Question could be true or false, depending on perception of question.

ATTACHMENT 4

NRC RESOLUTIONS TO FACILITY COMMENTS

The following represents the NRC resolution to those comments made by the facility as a result of the current examination review policy.

Only those comments resulting in significant changes to the master answer key, or were "not accepted" by the NRC, are listed and explained below. Comments made that were insignificant in nature and resolved to the satisfaction of both the examiner and the Licensee during the post examination review are not listed i.e.: typographical errors, relative acceptable terms, minor set point changes.

1.1.b. Comment noted. However, the caution discussed in the question is in OP-201 and, as such, should not lead the candidate to assume "cold clean startup".

1.1.b.(2) The purpose of this question was to elicit this comment as an answer.

1.2 This comment was not accepted. Both answers will be required for full credit based on examiners clarification of the question during the examination.

1.3 Comments accepted however, candidate will have to include a discussion of drywell pressure and temperature changes.

1.6 This comment was not accepted. Purpose of question was not to test the candidates knowledge of separator design but rather to elicit a thermodynamic discussion of steam properties in general. The question asks how "may" cycle efficiency be increased and the answer is discussed in the lesson plan.

2.3 Comment accepted. Proper reference material provided.

2.4 Comment accepted. Proper reference material provided.

2.7 Comment accepted. This is an acceptable alternate answer.

2.8 Comment accepted. Second sentence in answer was not asked for in question.

3.6 Comment noted. However, examiners noted that when at minimum recirc flow (as seen in control room) the alarm is not in. Calculation of temperature effect using steam tables indicates procedure is probably correct.

4.07 Not accepted, candidates should be aware for the reason (bases) for precautions. Specific word for word memorization not required.

4.11 Comment considered during grading for system operation not memorization.

5.03 Comment accepted. This is an acceptable alternate answer.

7.03 Comment accepted. Proper reference material provided. Candidates will be graded according to which section they select as answer.

8.03 Comment accepted. Proper reference material provided.

8.05 Comment accepted. Examiner misinterpreted applicable Tech. Spec.

8.08 Comment accepted. Proper reference material provided.