ENCLOSURE 1

EXAMINATION REPORT - 50-413/OL-86-01

Facility Licensee: Duke Power Company

Facility Name: Catawba

Facility Docket Nos.: 50-413 & 50-414

Written and oral examinations were administered at Catawba Nuclear Station near Clovers, South Carolina.

Chief Examiner: David Nelson — 11-17-86
David Nelson — Date Signed

Approved by: for William M. Dean — 11/28/86
John F. Munro, Section Chief — Date Signed

Summary:

Examinations on September 2-4, 1986

Oral examinations were administered to twelve candidates; all of whom passed. Written examinations were administered to twelve candidates; eleven of whom passed.

Based on the results described above, seven of seven ROs passed and four of five SROs passed.

REPORT DETAILS

1. Facility Employees Contacted:

*H. B. Barron, Superintendent of Operations
*W. Barron, Operations Training Superintendent
*D. Tower, Shift Operating Engineer
*C. T. Kiker, Operations Training Instructor

*Attended Exit Meeting

2. Examiners:

A. J. Vinnola, Jr., INEL
W. C. Hemming, INEL
N. C. Jensen, INEL

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners provided the facility training personnel with a copy of the written examination and answer key for review. The comments made by the facility reviewers are included as Enclosure 3 to this report, and the NRC Resolutions to these comments are listed below.

a. RO Exam:

(1) Question 1.15

Resolution: From the references provided there are two reasons that nucleate boiling is desired. One, was originally listed on the answer key. Two, was provided by the facility in their comments. Both are required for full credit.

(2) Question 1.17 b.

Resolution: The additional answers supplied by the facility were verified to be correct, added to the answer key and graded accordingly.

(3) Question 1.20 b.

Resolution: Agree with comment. Credit will be provided if calculation shows this to be a log function and therefore shorter time.

(4) Question 2.08 b.2

Resolution: "Establishes correct pH" was verified to be an additional correct answer and added to the answer key and graded accordingly.

(5) Question 2.11

Resolution: Because the question did not specify the size of the NC leak, it could have been assumed a large break LOCA and if assumed then the facility provided additional answers are acceptable. However, EMF 53A/B is only one instrument with two channels and therefore is considered as one instrument.

(6) Question 2.12 a. 1.

Resolution: Setpoints were specifically asked for in the question and therefore are required for full credit. If candidate states the proper names of the valves that are affected instead of valve numbers, he will receive credit.

(7) Question 2.13 c.

Resolution: "Trip" controller was changed to "Load Rejection" controller after verification of reference supplied with the facility comments.

(8) Question 2.15

Resolution: Answer key changed to require either feed or steam isolation.

(9) Question 2.20

Resolution: After verification of reference material, "Smoke" removed from the answer key and graded accordingly.

(10) Question 3.01

Resolution: It is true that C may or may not be correct. It also depends upon the status of Impulse pressure. Because this was not clear in the original question, C could also be not correct. It is also incorrect because P-7 is not exclusively controlled by the excore nuclear instruments. The answer key was changed to accept either "b" or "c".

(11) Question 3.02

Resolution: Only the "Both" will be accepted, because of 3 of 4 channels are grater than 82.4% in the Steam Generators either Unit will have a high-high water level trip actuated because the Unit 2 setpoint is lower than 82.4%.

(12) Question 3.08 d.

Resolution: The answer key changed to the correct description as stated in SRO question 6.13.

(13) Question 3.09.b

Resolution: After review of the facility provided reference logic diagram the answer key was changed to reflect the facility provided answer.

(14) Question 3.10 c.

Resolution: For level to be constant the flow error must be overcome by the level error. This means that a level error must exist. For a level error to exist in a steady state condition, actual level must be lower than programmed level. No change to answer key is necessary.

(15) Question 3.11 b.

Resolution: The question asks for programmed pressurizer level. Programmed means planned or scheduled. This is the desired level. Therefore, accepting a band of answers would insinuate accepting other than the desired level and this not what the question asks. No change was made to the answer key.

(16) Question 3.12 a.

Resolution: After reviewing the turbine trip logic two of the following will be accepted for full credit:

1. Mechanical Trip Solenoid Valve (125 VDC Trip Bus)
2. Manual Trip Handle
3. Mechanical Overspeed Trip Device

(17) Question 3.15

Resolution: Answer key changed accordingly based on the additional reference material provided by the facility.

(18) Question 4.02

Resolution: The facility comment requests an additional answer be accepted, however, the facility has no reference for this action. Referring to Abnormal Procedure; AP/1/A/5500/21, has two caution statements that verifies the answers as listed on the answer key. No change to the answer key was made.

(19) Question 4.06.b

Rsolution: The answer given in the answer key was derived assuming rods had already been reinserted. However, because this was not specifically stated in the question either 2 or 5 will be accepted as a correct answer.

(20) Question 4.08

Resolution: This typographical error was corrected on the answer key.

(21) Question 4.13 That portion of the answer was unintentionally omitted.

Resolution: Either answer will be accepted for full credit.

b. SRO exam

(1) Question 5.15 See RO Comment 1.15

(2) Question 5.17 See RO Comment 1.17

(3) Question 5.20 See RO Comment 1.20

(4) Question 6.02 See RO Comment 2.15

(5) Question 6.04

Resolution: Answer key changed to indicate the reference level in A&D steam generators are affected.

(6) Question 6.06

Resolution: The answer provided on the answer key was the design basis answer, however, because the question did not specifically ask for the design basis, a band of 115 to 125 degrees will be accepted.

(7) Question 6.17

Resolution: Because 82% is listed in many of the discussions in the system handout, it will be accepted.

(8) Question 7.02

Resolution: The answer on the answer key was referenced to the Catawba Question Bank. Because the facility comment is more conservative and better answer from a good engineering/ operations practice standpoint, it will also be an acceptable answer, even though no reference is provided for the facility comment.

(9) Question 7.05

Resolution: The question refers to Duke's posting of radiation areas and therefore must be graded by Duke's HP procedures. The question does not ask for a definition.

(10) Question 7.06

Resolution: Answer verified and changed on the answer key.

(11) Question 7.07

Resolution: The Station Directive is more limiting in that an extension approval is required if a person receives 90% of an administrative limit. Therefore the correct answer is either 90% of 1000 mrem/qtr (900 mrem/qtr) or 90% of 2500 mrem/year (2250 mrem/yr).

(12) Question 7.15

Resolution: The question did not specifically ask for components to be used and therefore feed and bleed of the NCS will be accepted.

(13) Question 7.16

Resolution: The reduced concentration and higher flow rates are acceptable in accordance with the procedure.

(14) Question 7.18

Resolution: Either answer is acceptable, the facility's suggested answer is virtually a restatement of the original answer key.

(15) Question 7.28

Resolution: See RO comment 4.02

(16) Question 8.01

The original answer referenced an incorrect Tech Spec bases.

Resolution:

Answer key changed to the correct bases as inditified by the facility.

(17) Question 8.07

Resolution:

The question's point value is in accordance with applicable Examiner Standards.

(18) Question 8.09

Resolution:

If candidate explains the documentation required to completed this form, credit will be given.

(19) Question 8.11b

Resolution:

"His Designee" will be accepted for full credit.

(20) Question 8.12

Resolution:

Shift Supervisor and Assistant Shift Supervisor is required for full credit.

(21) Question 8.14

Resolution:

Because not all candidates were not provided clarification any of the following answers will be accepted for full credit. The question point value will be reduced accordingly.

1) If intent is to be deviated from, no deviation is allowed, without an approved procedure change.

2) If a procedure change is needed, temporary approval is required by two verbal approvals, one of which is a supervisor who holds an SRO License and the change is documented on the working copy procedure.

3) In an emergency, the Licensed Operator may deviate from the procedure if he feels the action is necessary to protect the safety of the public.

(22) Question 8.17

Resolution: After careful review of the Technical Specification definitions the leakage is "identified". Because it is "identified" it can not be "Pressure Boundary" leakage.

4. Exit Meeting

At the conclusion of the site visit the examiners met with representatives of the plant staff.

There were no generic weaknesses (greater than 75 percent of candidates giving incorrect answer to one examination topic) noted during the oral examination.

From the answers given by the candidates, it was noted that the candidates appeared to have received adequate guidance concerning their preparations for the oral examinations.

Because of the relatively short time between simulator training at McGuire and the examinations, candidates had difficulty in locating many control board switches and controllers. It was recommended that candidates receive more time to re-familiarize themselves with the Catawba control boards prior to their examinations.

The cooperation given to the examiners and the effort to ensure an atmosphere in the control room conducive to oral examination was also noted and appreciated.

The licensee did not identify as propriety any of the material provided to or reviewed by the examiners.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: CATAWBA 1

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 86/09/01

EXAMINER: VINNOLA, A.

CANDIDATE: MASTER

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
30.00	25.00	_____	_____	1.	PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
30.00	25.00	_____	_____	2.	PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
30.00	25.00	_____	_____	3.	INSTRUMENTS AND CONTROLS
30.00	25.00	_____	_____	4.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
120.00		_____ Final Grade			Totals

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

3. Use black ink or dark pencil only to facilitate legible reproductions.

4. Print your name in the blank provided on the cover sheet of the examination.

5. Fill in the date on the cover sheet of the examination (if necessary).

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.

8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.

9. Number each answer as to category and number, for example, 1.4, 6.3.

10. Skip at least three lines between each answer.

11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.

12. Use abbreviations only if they are commonly used in facility literature.

13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.

14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.

15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

16. If parts of the examination are not clear as to intent, ask questions of the examiner only.

17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

(2) Exam aids - figures, tables, etc.

(3) Answer pages including figures which are part of the answer.

b. Turn in your copy of the examination and all pages used to answer the examination questions.

c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.

d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION 1.Ø1 (2.ØØ)

Concerning the Moderator Temperature Coefficient (MTC), state whether the MTC value would be MORE NEGATIVE, LESS NEGATIVE, or NOT EFFECTED by each of the following. CONSIDER EACH SEPERATELY. Assume an undermoderated core.

a. Beginning of Cycle(BOC) to End of cycle(EOC).

b. Fission product poison buildup.

c. Increasing temperature of the moderator.

d. Insertion of control rods.

QUESTION 1.Ø2 (1.ØØ)

Choose the correct phrase to correctly complete the sentence.

As the core ages, the ratio of PU239 atoms to U235 atoms increases. This changing ratio causes the...

a. reactor period to decrease.

b. Void Coefficient to become less negative.

c. Moderator Temperature Coefficient to become less negative.

d. delayed neutron fraction to increase.

QUESTION 1.Ø3 (1.ØØ)

Which of the following statements concerning the power defect is correct?

a. The power defect is the difference between the measured power coefficient and the predicted power coefficient.

b. The power defect increases the rod worth requirements necessary to maintain the desired shutdown margin following a reactor trip.

c. Because of the higher boron concentration, the power defect is more negative at beginning of core life.

d. The power defect necessitates the use of a ramped Tavg program to maintain an adequate Reactor Coolant System subcooling margin.

(***** CATEGORY Ø1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.Ø4 (2.ØØ)

What are FOUR factors that affect the value of the Doppler Coefficent, (PCM/degree F) as the fuel rod ages?

QUESTION 1.Ø5 (1.ØØ)

Which of the following is the purpose of using Soluable Boron to control the excess reactivity of the reactor?

a. It does not affect the flux shape.

b. It does not affect rod worth.

c. It is cheaper than adding more rods.

d. It increases reactor loading rates.

QUESTION 1.Ø6 (1.ØØ)

Complete the sentence by choosing the correct answer from the choices below.

Delayed neutrons play a major role in the operation of the core because they ...

a. are born at (thermal) slow energy levels (less than 1 ev) and therefore are more apt to cause a fission as compared to being absorbed by a poison.

b. are considered as epithermal neutrons and therefore they will not travel far enough to leak out of the core.

c. are born so much later than the prompt neutrons and provide controlability during steady state operations and power transients.

d. provide 7Ø% of the fission neutron inventory and have higher importance factors associated with them as compared to prompt neutrons.

(***** CATEGORY Ø1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.Ø7 (1.ØØ)

What TWO conditions must exist for subcritical multiplication to occur?

QUESTION 1.Ø8 (1.ØØ)

Which one of the following statements concerning Xenon-135 production and removal is correct?

a. At full power, equilibrium conditions, about half of the Xenon is produced by Iodine decay and the other half is produced as direct fission product.

b. Following a reactor trip from equilibrium conditions, Xenon peaks because delayed neutron precursors continue to decay to Xenon while neutron absorption (burnout) has ceased.

c. Xenon production and removal increases linearly as power level increases; i.e., the value of 1ØØ% equilibrium Xenon is twice that of 5Ø% equilibrium Xenon.

d. At low power levels, Xenon decay is the major removal method. At high power levels, burnout is the major removal method.

QUESTION 1.Ø9 (1.5Ø)

How does control rod worth vary as a function of each of the following? Consider each independently.

a. The radial position in the core.

b. An increase in the RCS boron concentration.

c. An increase in the moderator temperature.

(***** CATEGORY Ø1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.10 (1.00)

Choose the CORRECT response. In order to maintain a 200 F subcooling margin in the RCS when reducing RCS pressure to 1600 psig, steam generator pressure must be reduced to approximately:

a. 845 psig

b. 645 psig

c. 445 psig

d. 245 psig

QUESTION 1.11 (1.00)

Which of the following describes the changes to the steam that occur between the inlet and outlet of a real (not ideal) turbine?

a. Enthalpy decreases, entropy decreases, quality decreases.

b. Enthalpy increases, entropy increases, quality increases.

c. Enthalpy constant, entropy decreases, quality decreases.

d. Enthalpy decreases, entropy increases, quality decreases.

QUESTION 1.12 (1.50)

If steam goes through a throttling process, indicate whether the following parameters will INCREASE, DECREASE, or REMAIN THE SAME.

a. Enthalpy

b. Pressure

c. Entropy

QUESTION 1.13 (1.00)

In addition to the fluid level, and pressure of the hotwell condensate, what is another VARIABLE contributor to the actual NPSH of the condensate hotwell pumps?

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

QUESTION 1.14 (1.5Ø)

From the words or phrases in parentheses, choose the most correct completion for each statement below.

a. The ratio of peak to average value of power distribution is known as (peaking factor /or/ thermal limit). (Ø.3)

b. The value of the Heat Flux Hot Channel factor will (increase /or/ decrease /or/ remain constant) when power is decreased. (Ø.3)

c. The Heat Flux Hot Channel factor limit (assures /or/ does not assure) that DNB will NOT occur during normal operation. (Ø.3)

d. Calculation of Enthalpy Rise Hot Channel factor assumes core power is (uniform /or/ not uniform) and flow through each channel is (the same /or/ different) throughout the core. (Ø.6)

QUESTION 1.15 (1.ØØ)

Why is Nucleate Boiling a desireable mechanism of heat transfer?

QUESTION 1.16 (1.ØØ)

The reactor is producing 1ØØ% rated thermal power at a core delta T of 42 degrees and a mass flow rate of 1ØØ% when a blackout occurs. Natural circulation is established and core delta T goes to 28 degrees. If decay heat is 2%, what is the core mass flow rate (in %)?

QUESTION 1.17 (2.ØØ)

a. What happens to the power required by a motor driven centrifugal pump as the discharge valve is throttled in the shut direction?

b. What are TWO effects of operating a motor driven centrifugal pump at or beyond a runout condition?

(***** CATEGORY Ø1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.18 (1.ØØ)

A variable speed centrifugal pump is operating at 18ØØ RPM with a flow rate of 4ØØ gpm at a differential pressure of 2Ø psi and requires power of 4Ø KW. If pump speed is increased to 2ØØØ RPM, what are the new values for FLOW RATE (in gpm), DIFFERENTIAL PRESSURE (in psi), and POWER (in kw) for the new speed?

QUESTION 1.19 (1.5Ø)

Compare the calculated Estimated Critical Position (ECP) for a startup 15 hours after a trip to the actual Critical Rod Position (ACP) if the following events/conditions occurred. Consider each independently. Limit your answer to:

1. ACP higher than ECP.
2. ACP lower than ECP.
3. ACP would not be significantly different than ECP.

a. One Reactor Coolant Pump is stopped one minute prior to criticality.

b. The steam dump pressure setpoint is increased to a value just below the Steam Generator PORV's.

c. The startup is delayed 2 more hours.

QUESTION 1.2Ø (2.ØØ)

a. If the reactor is operating in the power range, how long will it take to raise power from 2Ø% to 4Ø% with a +Ø.5 DPM Start-up rate?

b. Will it take the same amount of time to raise power from 4Ø% to 6Ø% if the same startup rate is maintained? EXPLAIN.

(***** CATEGORY Ø1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.21 (1.5Ø)

Would the Axial Flux Difference become MORE NEGATIVE or LESS NEGATIVE for the following conditions? ALSO STATE THE REASONING FOR YOUR CHOICE!

a. OT Delta-T runback from 1ØØ% power with rods in automatic.

b. Feed flow increases to the steam generators with rods in manual.

c. Xenon is building into the bottom of the core more than in the top of the core.

QUESTION 1.22 (1.5Ø)

Assume the reactor is Xenon free. It then is taken to criticality and the power is raised to 5Ø% at 5%/min.. If a trip occurs as power reaches 5Ø%, how will the Xenon concentration be trending in the following three situations?

Use one of the choices (1-5) below to answer the three questions.

1. Increasing towards peak Xenon concentration.
2. Increasing towards 1ØØ% equilibrium.
3. Decreasing toward a dip.
4. Decreasing toward zero percent power equilibrium value.
5. At zero percent equilibrium value.

a. One hour after the trip.

b. 24 hours after the trip.

c. If after 8 hours from the trip, the reactor was taken back to criticality and power returned to 5Ø% at 1%/min. What would be the trend as power reaches 5Ø%?

(***** CATEGORY Ø1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.23 (1.ØØ)

The reactor is critical at 1Ø,ØØØ cps when a Steam Generator PORV fails open. Assuming BOL conditions, no rod motion, and no reactor trip, choose the answer below that best describes the values of Tavg and nuclear power for the resulting new steady state. (POAH = point of adding heat).

a. Final Tavg greater than initial Tavg, Final power above POAH.

b. Final Tavg greater than initial Tavg, Final power at POAH.

c. Final Tavg less than initial Tavg, Final power at POAH.

d. Final Tavg less than initial Tavg, Final power above POAH.

(***** END OF CATEGORY Ø1 *****)

QUESTION 2.Ø1 (1.ØØ)

Choose the phrase that correctly completes the sentence.

The Chemical and Volume Control System removes excess Lithium via the...

a. cation bed demineralizer.

b. mixed bed demineralizer.

c. BTRS demineralizers.

d. volume control tank vent to the Waste Gas System.

QUESTION 2.Ø2 (1.ØØ)

Choose the phrase that correctly completes the sentence.

If the excess letdown (normal) seal return to the VCT is isolated, then the return flow is manually (NV 125B) diverted to the...

a. Reactor Coolant Drain Tank.

b. Pressure Relief Tank.

c. Containment Sump.

d. Reactor Coolant Sampling System.

QUESTION 2.Ø3 (1.ØØ)

What are the FOUR automatic close signals associated with the Orifice Isolation Stop Valves in the NV letdown system?

QUESTION 2.Ø4 (1.ØØ)

List FOUR Auxiliary Feedwater Pump suction water supplies.

QUESTION 2.Ø5 (1.ØØ)

List the FOUR Auxiliary Feedwater motor driven pumps' automatic start signals.

(***** CATEGORY Ø2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.Ø6 (1.ØØ)

Choose the phrase that correctly completes the following.

The Instrument Air after coolers are cooled by the ...

a. Low Pressure Service Water System.

b. Nuclear Service Water System.

c. Component Cooling Water System.

d. Recirculating Water System.

QUESTION 2.Ø7 (1.5Ø)

Indicate whether the following Main Steam (SM) system connections tap off UPSTREAM or DOWNSTREAM of the main steam isolation valves.

a. Atmospheric steam dump valves.

b. Atmospheric PORVs.

c. Main FWPT steam supplies.

QUESTION 2.Ø8 (2.3Ø)

a. During normal Ice Condenser operation, what holds the lower inlet doors shut? [Ø.6]

b. Following a 6" NC System cold leg break, the Ice Condenser System is actuated.

   1. Explain the cause of system actuation. [Ø.7]

   2. What are TWO functions of the Sodium Tetraborate? [1.Ø]

QUESTION 2.Ø9 (o.5Ø)

TRUE or FALSE?

Each NCP No. 1 seal bypass line has an individual control valve that can be operated from the main control board.

(***** CATEGORY Ø2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.1Ø (2.5Ø)

a. The NC Pump No. 1 seal water leakoff flow to the NV System is isolated upon Safety Injection Actuation. What is the design provision that maintains seal leakoff after the isolation valves are shut? [Ø.5]

b. What is the purpose of the NCP No. 1 seal bypass line? [Ø.5]

c. The NCP No. 1 seal bypass valve is normally left in the closed position. However, there are specific conditions that if occured, you are required to open the valve.

What are these TWO conditions, one of which if occurred, would require the opening of the valve? [1.Ø]

d. What is the maximum NC pressure that is permitted to exist if the No. 1 bypass valve is to be opened? [Ø.5]

QUESTION 2.11 (2.4Ø)

If the process radiation monitor for Containment Air Particulate, 1-EMF-38, alarms, it indicates a possible NCS leak into containment. What are SIX other CONTAINMENT instruments or parameters that could also be used to verify a leak may actually exist?

QUESTION 2.12 (2.8Ø)

How are the CA pumps protected against: (Include setpoints.)

a. Excessive pump runout [1.4]
(Describe TWO protection schemes for only one motor driven pump.)

b. Minimum flow for motor driven [Ø.7]

c. Overspeed protection for turbine driven [Ø.7]

(***** CATEGORY Ø2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.13 (3.ØØ)

For each case below state the method of $RCS_{\Lambda}^{(NC)}$ temperature control that most correctly describes the final plant condition. Consider each case separately, assume initial normal system lineup for each case, include component/controller that is maintaining $RCS_{\Lambda}^{(NC)}$ temperature.

a. Steam pressure setpoint is reduced by 92 psi while at stable plant conditions awaiting reactor startup. Include Final Tave. [1.Ø]

b. The Steam Dump selector switch is placed in "off" while at 5% reactor power awaiting turbine startup. [1.Ø]

c. Train B reactor trip breaker fails to open upon a trip from 78% power. NOTE: Train A breaker opens. Include Final Tave. [1.Ø]

QUESTION 2.14 (1.ØØ)

State the purpose of the flow orifice in the cold leg accumulator (CLA) discharge line.

QUESTION 2.15 (1.5Ø)

With the plant operating at 1ØØ% power, a malfunction causes a loss of 1EDA, 125 VDC distribution center. Would you expect the plant to trip? Briefly explain your answer.

QUESTION 2.16 (1.ØØ)

What type of radiation does the Reactor Coolant System radiation detector (EMF-48) monitor? Choose from Alpha, Beta, Gamma or neutron.

QUESTION 2.17 (1.5Ø)

List THREE water sources for the Spent Fuel Pool.

QUESTION 2.18 (1.5Ø)

How does the instrument air (VI) system automatically respond to a continued decreasing pressure condition? Include setpoints.

(***** CATEGORY Ø2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.19 (1.ØØ)

a. State TWO purposes of the spray valve bypass flow. [Ø.8]

b. What design feature aids the driving force of PZR spray? [Ø.2]

QUESTION 2.2Ø (1.5Ø)

a. What type of fire protection system is provided for the Emergency Diesel generators? [Ø.6]

b. State THREE ways this system can be activated. [Ø.9]

(***** END OF CATEGORY Ø2 *****)

QUESTION 3.Ø1 (1.ØØ)

Which one of the statements below regarding the excore nuclear instrumentation controlled interlocks is NOT correct?

a. In order to block the high level reactor trip associated with the source range instrument, only one out of two intermediate range instruments greater than 1E-1Ø amps is required.

b. P-7, P-8, and P-1Ø are the only power range instrumentation interlocks with permissive (blocking) capabilities.

c. P-7 will cause the "at power" reactor trips to be blocked when 3 of 4 power range channels are < 1Ø%.

d. P-1Ø, when actuated, will de-energize the source range instruments if they are still energized.

Note for future exams: C should be amplified before using again

QUESTION 3.Ø2 (1.5Ø)

Indicate whether the statements below apply to UNIT 1, UNIT 2, or BOTH UNITS.

a. To activate the S/G low-low water level reactor trip it takes 2 out of 4 channels on 1 out of 4 steam generators indicating less than 17% for all power levels.

b. 3 out of 4 channels greater than 82.4% will actuate the S/G high-high water level trip.

c. The programmed S/G level is dependent upon nuclear power.

(***** CATEGORY Ø3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.Ø3 (1.ØØ)

Which one of the statements below regarding pressurizer pressure control is correct?

a. All 4 channels can be used to control system pressure by controlling heater banks A, B, C, and D and the automatic spray valves, although only one channel can be used at a time.

b. The PORV auto block signals are normally initiated from Channels I and III, although Channels II and IV can be substituted for them respectively.

c. It is possible, using the Pressurizer Pressure Control Select switch, to control PORV actuation and interlock signals, though not for the same PORV.

d. The master pressure controller calculates the difference between actual and reference pressure, as well as accounting for the length of time an error has been present, in generating its control signal.

QUESTION 3.Ø4 (1.ØØ)

Which one of the following statements regarding feedwater pump turbine speed control is correct?

a. At least one of the two Westinghouse controllers and one of the GE controllers must be in "auto" for flow balance compensation to be in effect.

b. The Westinghouse controller is used for starting up the feedwater pumps while in the "manual" mode and it is placed in "auto" when the pump is on line.

c. The pump speed demand signal is developed from the comparison of the difference between the steam pressure and feed pressure with programmed D/P signal.

d. Flow balance compensation is in effect when the Westinghouse FWP A is in automatic, with no regard for the status of the other FWP, as the setpoint potentiometer is on FWP A's M/A station.

(***** CATEGORY Ø3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.Ø5 (1.ØØ)

Which one of the following statements regarding the Digital Rod Position Indication System is correct?

a. LED's indicate six step increments of rod position from the bottom.

b. There is one "general warning" (GW) LED per group at the top of the column to indicate a problem in position calculation.

c. A lighted number on a Central Control Unit (CCU) indicates a data cabinet error.

d. An urgent alarm, general warning and rod bottom LED flashing indicates that the central control unit has been automatically or manually disconnected from the system.

QUESTION 3.Ø6 (1.ØØ)

Explain why the Rod Control Urgent Failure reset pushbutton should not be depressed for > 1 second.

QUESTION 3.Ø7 (1.ØØ)

Which one of the following statements regarding the Rod Control system is correct?

a. While moving the shutdown banks, rods are moved at a speed of 3Ø inches/minute.

b. An interlock prevents having more than one group of rods from being placed on "DC Hold" at one time.

c. Individual bank outward motion is prevented when the "Rod Control Urgent Failure" alarm energized.

d. The bank overlap unit (BOU) will not count steps if the Bank selector switch is not in "auto" or "manual".

(***** CATEGORY Ø3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.Ø8 (2.ØØ)

State the control function/interlock associated with the following. INCLUDE setpoints and coincidence.

a. C-1

b. C-3

c. C-11

d. C-16

QUESTION 3.Ø9 (2.4Ø)

During normal operation at 75% power if a single Power Range channel upper detector fails high; procedure, AP/1/A/55ØØ/16, requires that the failed channel be defeated. Explain why the following actions must be taken. Include setpoints and control systems being defeated.

a. Place the Rod Stop Bypass switch in bypass.

b. Place the Power Mismatch Bypass switch in bypass.

c. Place the Upper and Lower Section Selector switches to the failed channel.

d. Select the failed channel on the Comparator Channel Defeat switch.

QUESTION 3.1Ø (2.5Ø)

a. What are the FIVE plant parameter input signals used by the Steam Generator Level Control System, for Unit 1? [1.Ø]

b. Indicate whether feedwater flow would initially INCREASE, DECREASE, or NOT CHANGE if the controlling S/G pressure transmitter failed high during 5Ø% power operation. Briefly explain your answer. [Ø.75]

c. Indicate whether actual S/G level will be HIGHER, LOWER, or THE SAME, after 15 minutes, if the controlling feed flow channel fails high. Briefly explain your answer. [Ø.75]

(***** CATEGORY Ø3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.11 (3.ØØ)

a. What input signal is used to provide the level index for programmed pressurizer level control? [Ø.4]

b. What is the normal programmed pressurizer level at no load and full load? [Ø.6]

c. If the pressurizer level control channel fails HIGH during 1ØØ% power operation, what Reactor Protection signal will cause the reactor to trip? Provide a brief explanation of why the trip occurred and the SEQUENCE of events that led to the trip. ASSUME NO OPERATOR ACTION. [2.Ø]

QUESTION 3.12 (2.6Ø)

Question replaced by examiner during exam.

a. What EHC interlocks must be satisfied before "Stage Pressure Feedback" is operational? Include setpoints. [1.2]

b. If during automatic operation at 5Ø% power, the turbine control valve 3 malfunctions and fails shut in 5 seconds, what will happen to turbine load AND what occurs that causes the turbine load to change? [1.4]

QUESTION 3.13 (1.ØØ)

What is the effect of depressing the sequencer reset buttom while sequencing is in progress during a blackout?

QUESTION 3.14 (2.ØØ)

If a CF leak occurs in a doghouse, state EIGHT of the TEN automatic actions associated with a Unit 2 Hi-Hi doghouse level.

QUESTION 3.15 (1.ØØ)

If a loss of a feed pump (CF) occurred at 85% power, what would be the runback rate and at what power would it be terminated if the operator did not take action within the 3Ø second time delay?

3.12a List the TWO components that if, either or both are actuated, will trip the Mechanical-Hydraulic Trip System. (1.2)

QUESTION 3.16 (1.00)

What would cause an automatic closure of the component cooling (KC) thermal barrier return isolation valve? Setpoint not required.

QUESTION 3.17 (1.00)

How does the VC-YC system respond to a station blackout if NO trains were running prior to the blackout?

QUESTION 3.18 (1.00)

All four NCP motor feeder breakers automatically trip when the Reactor Coolant Pump Monitor senses under frequency.

If this feature was not available, what would be the effect on the operation of the pump AND what would be the safety analysis impact?

QUESTION 3.19 (1.00)

When a Safety Injection Signal starts the four RN Pumps, other actions occur as a result of the RN pumps automatically starting.

What are those automatic actions?

QUESTION 3.20 (1.00)

What condition will ~~result in~~ cause an automatic ~~response~~ swap of the auto static transfer switch in the auxiliary control power system? Setpoints not required.

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

QUESTION 3.21 (1.ØØ)

Which one of the following statements concerning OP delta T or OT delta T is correct?

a. The OP delta T instrument has a pressure input which provides DNB protection.

b. The OP delta T instrument has a pressure input which provides KW/FT protection.

c. The OT delta T instrument has a pressure input which provides DNB protection.

d. The OT delta T instrument has pressure input which provides KW/FT protection.

(***** END OF CATEGORY Ø3 *****)

QUESTION 4.Ø1 (1.ØØ)

On a power increase from 15% to 75% power, the following actions are performed.

a. Start a second CF pump

b. Verify SSRH highload valves automatically open

c. Check OAC thermal output measurement and have I&E adjust nuclear instrumentation as required.

d. Verify "P9 - Reactor Trip On Turbine Trip Permissive" light comes on.

What is the correct performance order of these actions? Put your answer in this format; e, g, f, i.

QUESTION 4.Ø2 (1.ØØ)

If KC and NV seal cooling for any NC pump is lost, within how many minutes AND from where must seal injection flow be initiated?

QUESTION 4.Ø3 (1.ØØ)

If a "Rod Control Urgent Failure" alarm occurs due to a failure in the logic cabinet, the Tave/Tref mismatch is maintained by which of the following?

a. controlling turbine load.

b. taking manual control of individual control rod banks.

c. taking manual control of individual control rod groups.

d. boration and dilution of the reactor coolant system.

QUESTION 4.Ø4 (2.ØØ)

CNS AP/1/A/55ØØ/Ø2, "Turbine Generator Trip", has an immediate action step to verify the generator tripped. What would be verified to ensure the generator had tripped?

(***** CATEGORY Ø4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.Ø5 (2.ØØ)

For the following paragraph, choose the correct word or words from the options given after the paragraph that correctly completes each blank.

When paralleling a diesel generator to the grid, the generator voltage should be ___a___ the line voltage. The diesel generator is synchronized to the grid by observing the synchro pointer as it moves slowly in the ___b___ direction and closing the generator breaker when the pointer is ___c___ the vertical position. The power (MW) output of the generator is then raised by adjusting the ___d___.

Choose from the following:

a. lower than / equal to / higher than

b. slow / fast

c. 5 minutes before / at / 5 minutes after

d. governor control / voltage regulator / stator cooling

(***** CATEGORY Ø4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.Ø6 (1.ØØ)

Match the required actions in Column B to the ECP and actual critical condition relationship in Column A. Example: "C. 8"

COLUMN A

a. Criticality achieved below the Tech Spec control rod insertion limit.

b. Criticality not reached prior to exceeding upper limit of the ECP band and ECP calculation verified by Performance Duty Engineer.

COLUMN B

1. No action required.

2. Fully insert control rods and recheck the ECP calculations.

3. Insert control rods to lower insertion limit and recheck ECP calculations.

4. Initiate boration at >/= 3Ø gpm of 7ØØØ ppmB while withdrawing rods to maintain criticality until the contol rods are above rod insertion limit.

5. Criticality may be achieved using 1/M Approach to Criticality procedure. (PT/1/A/415Ø/9)

QUESTION 4.Ø7 (1.5Ø)

a. When Steam Generators are pressurized and CF flow is not aligned to the Main Feed Nozzles, how is the feed nozzle containment penetration piping kept above the brittle fracture temperature?

b. If the S/G's are being fed from a source OTHER than main feed water, who must be notified of this condition?

QUESTION 4.Ø8 (1.ØØ)

There are conditions that require immediate initiation of Boron addition using 3Ø gpm of a solution containing 7ØØØ ppm Boron.

Your controlling procedures allow you to use a substitute higher flow rate with a lower Boron concentrated solution. What are the allowed higher flow rate AND lower Boron concentration?

(***** CATEGORY Ø4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.09 (1.00)

During normal plant operations, which of the following is the maximum S/G primary(NC) to secondary(SM) differential pressure? (1.0)

a. 1000 psid
b. 1200 psid
c. 1400 psid
d. 1600 psid

QUESTION 4.10 (1.50)

Match the RCS leakage Technical Specification rate limit in Column B to the type of leakage in Column A.

COLUMN A	COLUMN B
1. Pressure Boundary	a. 0 gpm
2. Identified	b. 1 gpm
3. Unidentified	c. 10 gpm
4. Controlled (at 2235 psig)	d. 20 gpm
5. Total Reactor-Secondary	e. 40 gpm
	f. 50 gpm

QUESTION 4.11 (1.00)

What are the operator's actions if, AFTER referring to a "Response Not Obtained (RNO)" action step, the expected RNO response can not be satisfied?

QUESTION 4.12 (1.00)

A reactor coolant pump should not be started unless the No. 1 seal delta P is greater than

a. 100 psi.

b. 200 psi.

c. 300 psi.

d. 400 psi.

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

QUESTION 4.13 (.5Ø)

It is the responsibility of the Control Room Operator to notify the Fire Brigade Captain when a fire is discovered. Who, by job title, is the Fire Brigade Captain?

QUESTION 4.14 (2.5Ø)

List the FIVE immediate operator actions for a reactor trip in accordance with the Emergency procedure EP/1/A/5ØØØ/Ø1. Sub-steps are not necessary for full credit. DO NOT include response not obtained steps!

QUESTION 4.15 (1.ØØ)

What TWO individuals, by title, may fill role of Emergency Coordinator?

QUESTION 4.16 (1.ØØ)

When the reactor is shutdown, what must be done before positive reactivity can be added by boron dilution?

QUESTION 4.17 (1.ØØ)

A turnover sheet is NOT required for short term shift relief during shift if THREE conditions are met. State the THREE conditions.

(***** CATEGORY Ø4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.18 (1.25)

If while operating the plant at 40% power and all 4 NC Pumps running, the "Seal Injection Filter A Hi D/P" and "NC Pump Seal Water Lo Flow" alarms actuate. The #1 seal outlet temperatures, KC flow from NC Pumps, and the NC Pump lower bearing temperatures are as follows:

NC PUMP	#1 SEAL OUT TEMP	KC FLOW FROM PUMP	LOWER BRG TEMP
A	225	39 gpm	215
B	220	40 gpm	227
C	230	41 gpm	220
D	215	38 gpm	210

All temperatures are rising slowly (<1 degree/min).

At this point in time, what are the required actions?

QUESTION 4.19 (2.00)

While refueling Unit 1, you receive a "ND Pump A Discharge High Pressure" alarm and note that NC temperature is increasing, while at the same time ND flow is decreasing.

List all the immediate actions (in accordance with AP/1/A/5500/19, "Loss of ND Train") including any parameters that are verified in these actions, and INCLUDE action concerning fuel that is in transit.

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

QUESTION 4.2Ø (1.75)

a. On a steam generator overpressurization event for 'B' steam generator, what is the correct PRIORITY (in order of highest to lowest) of the following methods used to depressurize the affected S/G? [1.Ø]

1. MSIV bypass
2. S/G PORV
3. Turbine driven CA pump
4. MSIV

b. If normal containment conditions exist, what is the MAXIMUM S/G level that can exist, before you are CAUTIONED NOT to release steam from the affected S/G? [Ø.75]

QUESTION 4.21 (1.ØØ)

If a void exists in the reactor vessel, which approach below represents the preferred actions taken to collapse the void in EP/1/A/5ØØØ/2F3, "Void in Reactor Vessel"?

a. Decrease temperature while maintaining system pressure.

b. Start a SI pump to increase system pressure while keeping temperature constant.

c. Increase system pressure using pressurizer heaters while maintaining pressurizer level.

d. Fill pressurizer solid and vent the reactor vessel head.

QUESTION 4.22 (1.ØØ)

Following a valid reactor trip and safety injection, complete the statement below, that describes the NC Pump Trip Criteria.

"SI flow indicated and _____."

ASSUME that the "KC Supply Hdr Flow to NCP Brgs Low" alarm is NOT alarming.

(***** CATEGORY Ø4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.23 (1.ØØ)

If the following critical safety functions were all displayed orange, which one has priority?

a. Subcriticality.

b. Heat Sink.

c. Integrity.

d. Inventory.

QUESTION 4.24 (1.ØØ)

Which of the following is a 1Ø CFR 2Ø exposure limit?

a. 5 rem/year - whole body.

b. 1 rem/quarter - whole body.

c. 3 rem/quarter - whole body.

d. 12 rem/year - whole body.

(***** END OF CATEGORY Ø4 *****)
(********** END OF EXAMINATION **********)

EQUATION SHEET

$f = ma$

$w = mg$

$E = mC^2$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$W = v\Delta P$

$\Delta E = 931\Delta m$

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

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

$Pwr = W_f \dot{m}$

$P = P_o\ 10^{SUR(t)}$

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

$SUR = 26.06/T$

$T = 1.44\ DT$

$SUR = 26\left(\frac{\lambda_{eff}\rho}{\bar{\beta} - \rho}\right)$

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

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

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

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

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

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

$\Sigma = N\sigma$

$v = s/t$

$s = v_o t + \frac{1}{2}at^2$

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

Cycle efficiency = $\frac{\text{Net Work (out)}}{\text{Energy (in)}}$

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

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

$t_{\frac{1}{2}}(eff) = \frac{(t_{\frac{1}{2}})(t_b)}{(t_{\frac{1}{2}} + t_b)}$

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

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

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

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

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

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

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$M = (1 - K_{eff})_0/(1 - K_{eff})_1$

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

$\ell^* = 1 \times 10^{-5}$ seconds

$\lambda_{eff} = 0.1$ 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)

$R/hr = 6\ CE/d^2$(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 Btu = 778 ft-lbf

1 inch = 2.54 cm

$^\circ F = 9/5\,^\circ C + 32$

$^\circ C = 5/9\ (^\circ F - 32)$

MASTER

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 1.01 (2.00)

a. MORE NEGATIVE

b. MORE NEGATIVE

c. MORE NEGATIVE

d. MORE NEGATIVE

REFERENCE
ROWE Reactor Operator Training Manual, pp 3-202 - 3-211
ZION - Westinghouse Fundamentals of Nuclear Reator Physics, pp 6-42 to 6-50
CNS, OP-CN-RC0-H0, pp 5-8

ANSWER 1.02 (1.00)

a.

REFERENCE
V. C. Summer Reactor Theory, I-5.80
HBR RXTH-HO-1 Session 23 p. 3
CNS, OP-CN-HO-RK, pp 10-12

ANSWER 1.03 (1.00)

b

REFERENCE
Westinghouse Reactor Physics, pp. I-5.26 & 27
HBR RXTH-HO-1 Session 32 pp. 3, 4
CNS, OP-CN-RCO-HO, pp 12 & 13

ANSWER 1.04 (2.00)

1. Clad creep.
2. Plutonium 240 buildup.
3. Fission gas buildup.
4. Fuel densification.

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

REFERENCE
CNS, OP-CN-RCO-HO, pp 10-11

ANSWER 1.05 (1.00)

a.

REFERENCE
Duke Power; Fundamentals of Nuclear Reactor Engineering, P. 170

ANSWER 1.06 (1.00)

c.

REFERENCE
SQNP, Review of Neutron Kinetics, p. 5 KA001/000,K5.49,2.9.
Cook Theory, Pp. I-3.3-10.
Zion, NUS book 3, section 5.5.
CNS, OP-CN-HO-RH, pp 10-12
BWD, Westinghouse Large PWR Core Control, Ch. 7, Pp. 23-30.

ANSWER 1.07 (1.00)

1. neutron source present
2. fissionable fuel present [0.5 each]

REFERENCE
CNS, OP-CN-HO-SCM, p. 3

ANSWER 1.08 (1.00)

d.

REFERENCE
Westinghouse Reactor Physics, pp. I-5.63-76.
HBR, Reactor Theory, Sessions 38 and 39.
DPC, Fundamentals of Nuclear Reactor Engineering, Section VI.
CNS, CN-OP-RP-HO, pp 3-9

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 1.09 (1.50)

a. Rod worth increases from the outside edge to the middle. or (The higher flux regions have higher rod worth)

b. Rod worth decreases.

c. Rod worth increases.

REFERENCE
Catawba Question Bank
HBR RXTH-HO-1 Session 35 pp. 2-7

ANSWER 1.10 (1.00)

d

REFERENCE
Steam Tables

ANSWER 1.11 (1.00)

d

REFERENCE
MNS OP-SS-HT-2, p.12.
Westinghouse Thermal-Hydraulic Principles and Applications to PWR II Chapter 7
CNS Exam Bank

ANSWER 1.12 (1.50)

a. REMAIN THE SAME
b. DECREASE
c. INCREASE

REFERENCE
Steam Tables

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 1.13 (1.00)

Temperature

REFERENCE
CNS, EXAM BANK

ANSWER 1.14 (1.50)

a. Peaking Factor (0.3)

b. Increase. (0.3)

c. Does not assure. (0.3)

d. Not uniform, [0.3] The same [0.3] (0.6)

REFERENCE
HBR GP HTFF pp. 193-198
Thermal-Hydraulic Principles, Pp. 13- 30 thru 36
CNS Exam Bank

ANSWER 1.15 (1.00)
[Two Reasons Required]

1. It increases the total heat transfer coefficent (agitation) (by mixing the boundary layer). (Better heat transfer because of the bubbles leaving the cladding and breaking up the boundary/film layer.)[0.5]

2. Also, there is an increase in heat transfer rate because of the heat transferred by way of forming the bubbles, ie. latent heat of vaporization.[0.5]

REFERENCE
CNS, OP-CN-THF-HT-HO, p. 6
Westinghouse Thermo, p. 68.
CNS, Heat Transfer Text, p. 306.

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 1.16 (1.00)

[-0.1 for math errors]

To determine flow:

At 100% power:

$$Q = \dot{m}\, cp\, \Delta T \Rightarrow 100 = 100 * cp * 42 \Rightarrow cp = \frac{100}{100 * 42}$$

At decay heat:

$$2\% = \dot{m} * Cp * 28 \Rightarrow Cp = \frac{2}{\dot{m} * 28}$$

THEN: $\frac{1}{42} = \frac{2}{\dot{m}\ 28}$ AND; $\dot{m} = \frac{2\% * 42}{28} = 3.0\%$

REFERENCE

General Physics, HT & FF, Section 3.2
ROWE Reactor Operator Training Manual, Sec. 2, pp 54-63
Westinghouse Thermal-Hydraulic Principles and Applications to PWR II
Chapter 14, pp 15-29
CNS, OP-CN-THF-HT-HO, pp 1-2

ANSWER 1.17 (2.00)

a. power decreases. [1.0]

b. 1. overload of motor (trip of the motor breaker)
2. cavitation [0.5 each] [Two Required]
3. Pump efficiency
4. Overheat of pump (bearings)

REFERENCE
CNS, OP-CN-FF-HO, pp 6-8
CNS, OP-CN-THF-FF, p. 16.

ANSWER 1.18 (1.00)

444 GPM
25 PSI (24.64)
55 KW (54.71)

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

REFERENCE
CNS, OP-CN-FF-HO, pp 4-6

ANSWER 1.19 (1.50)

a. 3. (same)

b. 1. (ACP higher)

c. 2. (ACP lower) [0.5 ea.]

REFERENCE
SQNP, Review of Core Poisons, pp. 4 - 7 KA001/000,K5.18,4.2.
Cook Theory, Pp. I-36-45.
Zion, NUS book 3, section 12.5.
CNS, CN-OP-RP-HO, p. 4
OP-CN-RCO-HO, pp 4-8

ANSWER 1.20 (2.00)

a. 36 seconds. (+/- 2) [1.0]

b. No.[.25] Power escallation is a log function and therefore increases at an increasing rate. [.75] (If candidate provides log formula or calculates the time to be shorter, credit will be given)

REFERENCE
Cook Theory, Pp. I3.15-16. KA001/010,K5.37,3.2.
Zion, NUS book 3, section 6.4
CNS, OP-CN-HO-RK, pp 3-7

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 1.21 (1.50)

a. MORE NEGATIVE [0.25] because rods are inserted and push the flux to the bottom of the core [0.25]

b. MORE NEGATIVE [0.25] because more moderation will occur in the bottom of the core (due to T-cold decreasing) [0.25]

c. LESS NEGATIVE [0.25] because Xe inserts MORE negative reactivity in the bottom of the core ~~and~~ than in the top of the core. [0.25]

REFERENCE
Rx Th pgs. 196-210, 232-233
TS pgs. 1-1 and B 3/4 2-1

3.1 001 000 K 5.06 3.8
K 5.38 3.5

ANSWER 1.22 (1.50)

a. (1) Increasing towards peak Xenon concentration.

b. (4) Decreasing toward zero percent power equilibrium value.

c. (3) Decreasing toward a dip. [0.5 ea.]

REFERENCE
HBR Reactor Theory Rxth-ho-1 Session 39 pp. 3-8
CNS, OP-CN-RCO-HO, pp 2-8

ANSWER 1.23 (1.00)

d.

REFERENCE
Westinghouse Reactor Physics, Section I-5, MTC and Power Defect
DPC, Fundamentals of Nuclear Reactor Engineering
HBR RXTH-HO-1 Session 48 pp. 3-8
CNS, OP-CN-RCO-HO, pp 2-8
002/000-K5.02 (3.3/3.6)

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 2.01 (1.00)

a

REFERENCE
MNS OP-MC-SPS-SY-NV, p.10.
CNS OP-CN-HO-NV; p. 11

ANSWER 2.02 (1.00)

a

REFERENCE
MNS OP-MC-SPS-SY-NV, p.19.
CNS OP-CN-HO-NV, pp.36, 43.

ANSWER 2.03 (1.00)

1. Low PZR Level
2. Cntmt. isolation (ST)
3. L/D isolation valves (NV 1&2) go shut
4. All 3 charging pumps tripped.

REFERENCE
CNS OP-CN-HO-NV; P. 8

ANSWER 2.04 (1.00)

1. UST, Upper Surge Tank
2. CA Condensate Storage Tank.
3. Condenser Hotwell.
4. Nuclear Service Water (Lake) (RN).
5. RC ~~(CAF)~~ [any four @ 0.25 each]

REFERENCE
MNS OP-MC-SPS-SY-CA, p.8.
CNS, OP-CN-HO-CA, P. 3

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 2.05 (1.00)

1. (2/4) Low low level in any SG.
2. Trip of both main feedwater pumps.
3. Ss signal.
4. Blackout signal (2/3 UV relays on the essential ~~loss~~ bus).

REFERENCE
MNS OP-MC-SPS-SY-CA, p.9.
CNS CA Lesson Plan, p.8.

ANSWER 2.06 (1.00)

a

REFERENCE
MNS OP-MC-SPS-SY-VI, p.8.
CNS PSM CN-SY-VI, p.4.

ANSWER 2.07 (1.50)

a. DOWNSTREAM
b. UPSTREAM
c. DOWNSTREAM

REFERENCE
CAT, Figure CN-SYS-SM-1
039/000-K1.02 (3.3/3.3)
-K1.08 (2.7/2.9)

ANSWER 2.08 (2.30)

a. Cold (more dense) air [0.6]

b. 1. lower containment pressure increases (1psf), this opens the lower inlet doors providing a flow path (intermediate then top doors open). [0.7]

2. a. Retains iodine [Two Required]
b. Absorbs neutrons
c. (Serves as a cooling medium) [0.5 each]
d. Establishes correct (9.0 to 9.5) pH.

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

REFERENCE
CAT, NF Lesson Plan, PP. 6, 10, 23
CNS, Tech. Spec. p. 3/4 6-41. Ice Condenser Description, para. 6.5.4.2.

ANSWER 2.09 (0.50)

False

REFERENCE
CNS, CN-PSM-PS-NCP; P. 3

ANSWER 2.10 (2.50)

a. Diverted to the PRT [0.1] via a relief valve. ~~[0.5]~~ [0.4]

b. To provide cooling to the lower radial bearing during low NC pressure conditions. [0.5] [.25]

c. 1. NCP bearing temperature (seal inlet temperature) greater than or or equal to 170 Deg. F. (Alarm setpoint) [0.5]

2. NCP No. 1 seal leakoff temperature greater than or equal to 200 Deg. F. [0.5]

d. 1000 psig [0.5]

REFERENCE
CNS, CN-PSM-PS-NCP; P. 3

ANSWER 2.11 (2.40)

Containment:
1. Pressure (increasing)
2. Temperature (increasing)
3. Humidity (increasing)
4. Sump level (increasing)
4a. Hydrogen monitor
5. 1-EMF-39 (gaseous) alarms
6. 1-EMF-40 (iodine) alarms
6a. EMF-53 A/B

Incore Instrument:
7. sump level (increases)
8. panel leak alarm
9. ice condenser door open (CAF) [6 required, 0.4 each]

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

REFERENCE
CAT,AP/1/5500/10 Encl.1

ANSWER 2.12 (2.80)

a. 1. If 7800 gpm [0.1] is reached, 58A (46B) will shut. [0.6] motor operated valve to S/G 'B' (C)

2. If one pump does not start within 30 sec [0.1] of start signal and the other pump running w/TDCA pump running, then the operating pump discharge valve to the B(c) S/G will shut. [0.7]

b. Recirc valve opens [0.6] at 90 [0.2] gpm [0.1] decreasing (and closes at 90 gpm [0.2] increasing) (+ - 5 gpm) ~~[0.7]~~

c. Electronic 110% T&T valve gravity/spring assist shuts. Mechanical 115% also trips mechanical linkage [0.7]

REFERENCE
CNS, OP-CN-HO-CA; PP. 9, 15

ANSWER 2.13 (3.00)

a. T.avg decreases to approximately P-12 setpoint. [1.0]

b. Secondary pressure rises to S/G PORV setpoint, (maintaining Tavg 560 F). [1.0]

c. Steam dump controlling by ~~trip~~ controller. [0.75] ~~[1.0]~~ Temp. No Load (557) plus 3°F deadband [0.25] Load Rejection

REFERENCE
CAT, OP-CN-HO-IDE, P. 4-7

ANSWER 2.14 (1.00)

To extend the blowdown time of the CLA during a LOCA (so as not to blowdown to sump).

REFERENCE
CNS, OP-CN-HO-CLA, P. 4

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 2.15 (1.50)

Yes [0.5]. Feedwater Isolation ~~and~~ (Main Steam Isolation) would occur causing the plant to trip on S/G level. [1.0]

REFERENCE
CNS, OP-CN-HO-EPL; P. 7

ANSWER 2 16 (1.00)

Gamma radiation

REFERENCE
CAT, CNS PSM Rad. Mon., CN-IC-EMF-9

ANSWER 2.17 (1.50)

1. FWST (0.5)
2. RMWST (0.5)
3. Nuclear Service Water (RN) (0.5)

REFERENCE
CAT, KF Lesson Plan, PP. 15-17

ANSWER 2.18 (1.50)

88 psig +/-2 [0.1] STBY #1 compressor fully loaded [0.4]
84 psig +/-2 [0.1] STBY #2 compressor fully loaded [0.4]
76 psig +/-2 [0.1] Station air (VS) auto loading to VI: (opens IVS-78) [0.4]
[+ 1.2 for correct sequence]

REFERENCE
CNS AP/O/A/5500/22; CN-OP-HO-VI, P. 7

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 2.19 (1.00)

a. 1. Maintains PZR at same chemistry as NC system. [0.4]

2. Prevents spray nozzle thermal shock. [0.4]

b. Spray scoops (allow velocity head of coolant flow to add to the driving force of spray). [0.2]

REFERENCE
CNS, OP-CN-HO-NC; P. 11, OP-CN-IPE-HO; P. 7

ANSWER 2.20 (1.50)

a. CO2 [0.6]
b. Heat, ~~smoke~~, manual [0.9]

REFERENCE
~~CAT, CN-SYS-RF/FY, P. 1~~
CNS, OP-CN-HO-RFY, P. 14.

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 3.01 (1.00)

b. or C

REFERENCE
CAT, SD-ENB, PP. 9, 10, 22, and 33

ANSWER 3.02 (1.50)

a. ~~Unit 2~~ Unit 2
b. ~~Unit 1~~ Both
c. Unit 1

REFERENCE
CNS, OP-CN-HO-IFE; PP. 2-3

ANSWER 3.03 (1.00)

d.

REFERENCE
CNS, OP-CN-IPE-HO; PP. 6-8

ANSWER 3.04 (1.00)

c.

REFERENCE
CNS, OP-CN-IWE-HO; PP. 2-4

ANSWER 3.05 (1.00)

a.

REFERENCE
CNS, OP-CN-HO-IRE, P. 18

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 3.06 (1.00)

To prevent overheating of the CRDM coils.

REFERENCE
CNS, OP-CN-HO-EDA, P. 2

ANSWER 3.07 (1.00)

d. (1.0)

REFERENCE
CNS, OP-CN-HO-IRE, PP. 5-9 and Plant Summary Manual - IRE, P. 5

ANSWER 3.08 (2.00)

a. Prevents auto/manual rod withdrawal [0.2] when 1/2 [0.1] IR [0.1] greater than 20% [0.1] power. ~~[0.5]~~

b. Prevents auto/manual rod withdrawal [0.2] when 2/4 [0.1] OT Delta T [0.1] > setpoint by 3% [0.1] (Also turbine runback - not required for credit.) ~~[0.5]~~

c. Prevents auto rod withdrawal [0.1] of Bank D [0.1] only when > 223 [0.1] steps. ~~[0.5]~~

d. Turbine loading inhibit [0.2] ~~on Tref - Tavg when Lo Tref is 2 Deg. > Tavg. [0.5]~~ when Tave drops below 553°F [0.15] or when Tave > 20°F below Tref [0.15]

REFERENCE
CNS, OP-CN-HO-IPX, PP. 13-14.
PP. 1 & 4

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 3.09 (2.40)

a. Defeat the 103% overpower rod stop. [0.6]

b. Defeats the failed P/R channel input to Rod Control, and S/G [0.3] ~~level control for Unit 1~~. Feed Regulating By Pass Valve [0.3]

c. Removes the faulty input to the Detector Current Comparator (Current Deviation Alarm) (axial). [0.6]

d. Removes the faulty channel input to the Channel Current Comparator (Channel Deviation Alarm) (quadrant). [0.6]

REFERENCE
CNS, AP/1/A/5500/16; P. 14

ANSWER 3.10 (2.50)

a. 1. Actual S/G level
   2. Steam flow
   3. Steam pressure
   4. Feed flow
   5. Nuclear power [1.0]

b. Increase [0.25] because the steam flow input signal will be increased. [0.5].

c. Lower [0.25] S/G level decreases until the Level Error signal overcomes the flow error [0.5].

REFERENCE
CNS, OP-CN-HO-IFE-1 and P. 6

ANSWER 3.11 (3.00)

a. Tave (auct high) [0.4]

b. 25.0%, 60.0% [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 to trip setpoint [0.4].

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

REFERENCE
CNS,CN-OP-ILE-HO, P. 9

ANSWER 3.12 (2.00)

a. [Two Required]
1. mechanical Trip Solenoid Valve (mTSV) (125v DC)
2. manual Trip Handle
3. mechanical Overspeed Trip

~~a. Auto Mode [0.4] Stagged Pressure > 20% of rated [0.4] and Throttle Pressure >95% of rated [0.4]. [1.2]~~

b. Turbine load decreases [0.4] then returns to 50% [0.4] Control valves 1,2,&4 open to compensate for the load change (SPF) [0.6]. [1.4]

REFERENCE
CAT, CN-SYS-EHC, PP. 7, 9
CNS, OP-CN-HO-MT3, p.14.

ANSWER 3.13 (1.00)

No further load groups will be applied.

REFERENCE
CAT, PSM CN-SYS-EQB

ANSWER 3.14 (2.00)

1. Both CF pumps trip
2. Both CF pump discharge valves shut
3. S/G CA nozzle tempering control valve (CF-100) shuts
4. S/G CA nozzle tempering isolation bypass valve (2CF-156) shuts (Unit 2 only)
5. Affected S/G's feedwater control valves shut
6. Affected S/G's feedwater bypass control valves shut
7. Affected S/G's feedwater containment isolation valves shut
8. Affected S/G's feedwater containment isolation bypass valves shut
9. Affected S/G's CF bypass CA nozzle valves shut
10. Affected S/G's tempering flow to CA nozzle valves shut [8 required, 0.25 each]

REFERENCE
CNS, OP-CN-HO-CF, PP. 23-24

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 3.15 (1.00)

10%/minute [0.5] < 70% [0.5].

REFERENCE
CNS, OP-CN-HO-EGB; P. 14

ANSWER 3.16 (1.00)

High flow in a return line.

REFERENCE
CNS, OP-CN-HO-KC, P. 10

ANSWER 3.17 (1.00)

The train receiving the start signal first will start.

REFERENCE
CNS, OP-CN-HO-VC; P. 11

ANSWER 3.18 (1.00)

The pump would undergo rapid deceleration caused by the decaying frequency [0.5]. This would significantly reduce flow because of the inertia of the flywheel (coastdown would be eliminated) [0.5].

REFERENCE
CNS, Exam Bank, Q-CM-NCP-06 and OP/CN/HO/NCP, P. 25

ANSWER 3.19 (1.00)

Pump discharge isolation valves [0.5] and motor cooler inlet isolation valves [0.5] (28A/38B/11A/20A) open.

REFERENCE
CNS, OP-CN-HO-RN: P. 52

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 3.20 (1.00)

Low inverter output voltage.

REFERENCE
CNS, ~~Exam Bank, Q-EL-EPF-06~~
OP-CN-EPF-140, p.5.

ANSWER 3.21 (1.00)

c.

REFERENCE
CNS, OP-CN-HO-IPX, PP. 6-7

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 4.01 (1.00)

a, c, b, d. (If two adjacent items are reversed; +[0.75]
If three items in correct sequence; +[0.75])

REFERENCE
CAT, OP/1/A/6100/03, p. 5

PWG-#29 (3.7/4.0)

ANSWER 4.02 (1.00)

1. 10 minutes

2. From the SSF(Standby Shutdown Facility)

REFERENCE
CNS, AP/1/A/5500/08, P. 2

000/015-PWG#21 (2.7/2.8)
-PWG#28 (4.4/4.4)

ANSWER 4.03 (1.00)

a.

REFERENCE
MNS, AP/2/A/5500/14, Case I, p.2.
CAT, AP/1/A/5500/15, Case I, p.2.

001/050-PWG#28 (4.4/4.4)

ANSWER 4.04 (2.00)

1. Gen Output Bkrs (1A and 1B): open [0.4]
2. MODs (1AG, 1AT, 1BG, 1BT): open [0.4]
3. Exc Field Bkr: open [0.4]
4. Gen DE-Exc Bkr (relay): open [0.4]
5. Man/Auto REG select switch "Man" light: lit [0.4]

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

REFERENCE
Cat, AP/1/A/5500/02, p. 3

ANSWER 4.05 (2.00)

a. Higher
b. Fast
c. 5 minutes ~~to~~ before
d. Governor control

REFERENCE
Cat, OP/0/B/6350/11, enclosure 4.4, pp. 1 - 2

ANSWER 4.06 (1.00)

a. 4
b. ~~or~~ 5

REFERENCE
Cat, OP/0/A/6100/06, pp. 1 - 2

ANSWER 4.07 (1.50)

a. By maintaining S/G Reverse Purge Flow. [0.75]

b. Secondary Chemist. [0.75]

REFERENCE
CAT, OP/1/A/6100/02, P. 2 of 2

ANSWER 4.08 (1.00)

~~150~~ to 5 gpm of 2000 ppmB.

REFERENCE
CAT, OP/1/A/6100/01, P. 14

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 4.09 (1.00)

d.

REFERENCE
Cat, OP/1/A/6100/02, p. 1

ANSWER 4.10 (1.50)

1. a.
2. c.
3. b.
4. e.
5. b.

REFERENCE
FNP,TS, p. 3/4 4-17
CNS, Technical Specifications, p 3/4-20.

ANSWER 4.11 (1.00)

Goes on with the procedure while still attempting the RNO action.

REFERENCE
CNS, Exam Bank, No. Q-EP-EP1-51

ANSWER 4.12 (1.00)

b

REFERENCE
MNS OP/1/A/6150/02A, p. 1.
CNS OP/1/A/6100/01, Encl. 4.1,2.17.

ANSWER 4.13 (.50)

Assistant Shift Supervisor or Control Room Operator

ANSWERS -- CATAWBA 1 -86/Ø9/Ø1-VINNOLA, A.

REFERENCE
CNS, Directives 2.12.1 & 2.12.2

ANSWER 4.14 (2.5Ø)

1. Manually trip reactor (exercise reactor trip train A & B switches).
2. Verify a reactor trippped (three substeps have occured).
3. Verify a turbine tripped (all main stop valves closed).
4. Verify 416ØV Essential power busses (ETA or ETB) are energized. (SWGR's ETA (or ETB) UV on Phase X (Y) (Z) status lights dark).
5. Check if SI is actuated (SI actuated status light is lit).

REFERENCE
MNS, AP/2/A/55ØØ/Ø1, p.3.
CNS, EP/1/A/5ØØØ/Ø1, p 2.

ØØØ/ØØ7-K3.Ø1 (4.Ø/4.6)

ANSWER 4.15 (1.ØØ)

Station Manager and Shift Supervisor.

REFERENCE
CNS, Station Directive 3.8.4 and Exam Bank No. 2-EP-SEP-Ø8

ANSWER 4.16 (1.ØØ)

All shutdown banks must be fully withdrawn.

REFERENCE
CNS, OP/1/A/6ØØØ/Ø1, P. 2

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 4.17 (1.00)

1. Person relieving is qualified. [0.333]

2. Person relieving has participated in on-shift activities and is aware of conditions. [0.333]

3. A verbal update is given to the person relieving by the person being relieved. [0.333]

REFERENCE
CNS, OMP 2-22, P. 3

ANSWER 4.18 (1.25)

Trip NC Pump 'B'[1.0] and refer to AP/1/A/5500/04 (Loss of Reactor Coolant Pump). [0.25]

REFERENCE
CAT, AP/1/A/5500/08, p. 2

000/015-A2.08 (3.4/3.5)
-PWG#27 (4.2/4.5)

ANSWER 4.19 (2.00)

a. Verify adequate ND suction supply [0.3]
   1. Pzr level > 10% or [0.1]
   2. NC vessel level > 10% [0.1]

b. Attempt to restore affected ND train [0.5]

c. Secure fuel handling operations [0.3]
   (if in transit) direct operators to place in safe position [0.2]

d. Maintain boron concentration stable [0.5]

REFERENCE
Cat, AP/1/A/5500/19, p. 2

ANSWERS -- CATAWBA 1 -86/09/01-VINNOLA, A.

ANSWER 4.20 (1.75)

a. 2, 1, 4, 3. [1.0] (If two adjacent items reversed; +[0.75]
If three items in correct order; +[0.75])

b. 95%. [0.75]

REFERENCE
CAT, EP/1/A/5000/2C2, pp. 3 - 4

ANSWER 4.21 (1.00)

c.

REFERENCE
CAT, EP/1/A/5000/2F3, pp. 4 and 5

ANSWER 4.22 (1.00)

(NC) Subcooling less than or equal to zero degrees F.

REFERENCE
CAT, EP/1/A/5000/01, Enclosure 1

ANSWER 4.23 (1.00)

a.

REFERENCE
MNS EP/2/A/5000/10, p.2.
CNS EP/1/A/5000/02, p.3.

ANSWER 4.24 (1.00)

c

REFERENCE
10 CFR 20.101

000/060-K1.02 (2.5/3.1)

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

FACILITY: CATAWBA 1 & 2

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 86/09/01

EXAMINER: HEMMING, W.

CANDIDATE: MASTER

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
30.00	25.00			5.	THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
30.00	25.00			6.	PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
30.00	25.00			7.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
~~30.00~~ 29.00	25.00			8.	ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
~~120.00~~ 119.00					Totals

Final Grade

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

Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

3. Use black ink or dark pencil only to facilitate legible reproductions.

4. Print your name in the blank provided on the cover sheet of the examination.

5. Fill in the date on the cover sheet of the examination (if necessary).

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.

8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.

9. Number each answer as to category and number, for example, 1.4, 6.3.

10. Skip at least three lines between each answer.

11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.

12. Use abbreviations only if they are commonly used in facility literature.

13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.

14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.

15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

16. If parts of the examination are not clear as to intent, ask questions of the examiner only.

17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

(2) Exam aids - figures, tables, etc.

(3) Answer pages including figures which are part of the answer.

b. Turn in your copy of the examination and all pages used to answer the examination questions.

c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.

d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION 5.01 (1.00)

Choose the correct phrase to correctly complete the sentence.

As the core ages, the ratio of PU239 atoms to U235 atoms increases. This changing ratio causes the...

a. reactor period to decrease.

b. Void Coefficient to become less negative.

c. Moderator Temperature Coefficient to become less negative.

d. delayed neutron fraction to increase.

QUESTION 5.02 (1.00)

Which of the following statements concerning the power defect is correct?

a. The power defect is the difference between the measured power coefficient and the predicted power coefficient.

b. The power defect increases the rod worth requirements necessary to maintain the desired shutdown margin following a reactor trip.

c. Because of the higher boron concentration, the power defect is more negative at beginning of core life.

d. The power defect necessitates the use of a ramped Tavg program to maintain an adequate Reactor Coolant System subcooling margin.

QUESTION 5.03 (2.00)

What are FOUR factors that affect the value of the Doppler Coefficent, (PCM/degree F) as the fuel rod ages?

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

QUESTION 5.04 (1.00)

The Reactor Protection System would become unreliable for DNB protection from the OT delta T trip if voids were allowed to form in the Reactor Coolant System because:

a. the heat transfer coefficient of the cladding is reduced significantly.

b. the specific heat capacity of the reactor coolant inventory changes when voiding occurs and is not measureable by the RTD's.

c. the critical point of water is reached and is not measureable by the RTD's.

d. entropy becomes more limiting than the enthalpy, which is not wihtin the design considerations of the Reactor Protection System.

QUESTION 5.05 (1.00)

Which of the following statements concerning Shutdown Margin (SDM) is correct?

a. The maximum SDM requirement occurs at EOL and is based on a rod ejection accident.

b. The maximum SDM requirement occurs at EOL and is based on a steam line break accident.

c. The maximum SDM requirement occurs at BOL and is based on having a positive Moderator Temperature Coefficient.

d. The maximum SDM requirement occurs at BOL and is based on a rod withdrawal accident while in the source range.

QUESTION 5.06 (1.00)

What TWO conditions must ~~exit~~ exist for subcritical multiplication to occur?

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

QUESTION 5.07 (1.00)

Which one of the following statements concerning Xenon-135 production and removal is correct?

a. At full power, equilibrium conditions, about half of the Xenon is produced by Iodine decay and the other half is produced as direct fission product.

b. Following a reactor trip from equilibrium conditions, Xenon peaks because delayed neutron precursors continue to decay to Xenon while neutron absorption (burnout) has ceased.

c. Xenon production and removal increases linearly as power level increases; i.e., the value of 100% equilibrium Xenon is twice that of 50% equilibrium Xenon.

d. At low power levels, Xenon decay is the major removal method. At high power levels, burnout is the major removal method.

QUESTION 5.08 (1.50)

How does control rod worth vary as a function of each of the following. Consider each independently.

a. The radial position in the core.

b. An increase in the ~~RCS~~ NC boron concentration.

c. An increase in the moderator temperature.

QUESTION 5.09 (1.00)

Choose the CORRECT response. In order to maintain a 200 F subcooling margin in the ~~RCS~~ NC when reducing ~~RCS~~ NC pressure to 1600 psig, steam generator pressure must be reduced to approximately:

a. 845 psig

b. 645 psig

c. 445 psig

d. 245 psig

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

QUESTION 5.10 (1.00)

Which of the following describes the changes to the steam that occur between the inlet and outlet of a real (not ideal) turbine?

a. Enthalpy decreases, entropy decreases, quality decreases.

b. Enthalpy increases, entropy increases, quality increases.

c. Enthalpy constant, entropy decreases, quality decreases.

d. Enthalpy decreases, entropy increases, quality decreases.

QUESTION 5.11 (1.50)

If steam goes through a throttling process, indicate whether the following parameters will INCREASE, DECREASE, or REMAIN THE SAME.

a. Enthalpy

b. Pressure

c. Entropy

QUESTION 5.12 (1.00)

In addition to the fluid level and pressure of the hotwell condensate, what is another variable contributor to the actual NPSH of the condensate hotwell pumps?

QUESTION 5.13 (2.00)

The reactor is operating at 30% power when one RCP trips. Assuming no reactor trip or turbine load change occur, indicate whether the following parameters will INCREASE, DECREASE, or REMAIN THE SAME.

a. Flow in any of the remaining operating reactor coolant loop.

b. Reactor VESSEL delta pressure.

c. Operating loop steam generator pressure.

d. Core delta Temperature.

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

QUESTION 5.14 (1.50)

From the words or phrases in parentheses, choose the most correct completion for each statement below.

a. The ratio of peak to average value of power distribution is known as (peaking factor OR thermal limit). (0.3)

b. The value of the Heat Flux Hot Channel factor will (increase, decrease, OR remain constant) when power is decreased. (0.3)

c. The Heat Flux Hot Channel factor limit (assures OR does not assure) that DNB will NOT occur during normal operation. (0.3)

d. Calculation of Enthalpy Rise Hot Channel factor assumes core power is (uniform OR not uniform) and flow through each channel is (the same OR different) throughout the core. (0.6)

QUESTION 5.15 (1.00)

Why is Nucleate Boiling a desireable mechanism of heat transfer?

QUESTION 5.16 (1.00)

The reactor is producing 100% rated thermal power at a core delta T of 42 degrees and a mass flow rate of 100% when a blackout occurs. Natural circulation is established and core delta T goes to 28 degrees. If decay heat is 2%, wh t is the core mass flow rate (in %)?

QUESTION 5.17 (2.00)

a. What happens to the power required by a motor driven centrifugal pump as the discharge valve is throttled in the shut direction?

b. What are TWO effects of operating a motor driven centrifugal pump at or beyond a runout condition?

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

QUESTION 5.18 (1.00)

A variable speed centrifugal pump is operating at 1800 RPM with a flow rate of 400 gpm at a differential pressure of 20 psi and requires power of 40 KW. If pump speed is increased to 2000 RPM, what are the new values for FLOW RATE (in gpm), DIFFERENTIAL PRESSURE (in psi), and POWER (in kw) for the new speed?

QUESTION 5.19 (1.50)

Compare the calculated Estimated Critical Position (ECP) for a startup 15 hours after a trip to the actual Critical Rod Position (ACP) if the following events/conditions occurred. Consider each independently. Limit your answer to:

1. ACP higher than ECP.
2. ACP lower than ECP.
3. ACP would not be significantly different than ECP.

a. One Reactor Coolant Pump is stopped one minute prior to criticality.

b. The steam dump pressure setpoint is increased to a value just below the Steam Generator PORV's.

c. The startup is delayed 2 more hours.

QUESTION 5.20 (2.00)

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 Start-up rate?

b. Will it take the same amount of time to raise power from 40% to 60% if the same startup is maintained? EXPLAIN.

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

QUESTION 5.21 (1.50)

Would the Axial Flux Difference become MORE NEGATIVE or LESS NEGATIVE for the following conditions? ALSO STATE THE REASONING FOR YOUR CHOICE!

a. OT Delta-T runback from 100% power with rods in automatic.

b. Feed flow increases to the steam generators with rods in manual.

c. Xenon is building into the bottom of the core more than in the top of the core.

QUESTION 5.22 (1.50)

Assume the reactor is Xenon free. It then is taken to criticality and the power is raised to 50% at 5%/min.. If a trip occurs as power reaches 50%, how will the Xenon concentration be trending in the following three situations?

Use one of the choices (1-5) below to answer the three questions.

1. Increasing towards peak Xenon concentration.
2. Increasing towards 100% equilibrium.
3. Decreasing toward a dip.
4. Decreasing toward zero percent power equilibrium value.
5. At zero percent equilibrium value.

a. One hour after the trip.

b. 24 hours after the trip.

c. If after 8 hours from the trip, the reactor was taken back to criticality and power returned to 50% at 1%/min. What would be the trend as power reaches 50%?

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

QUESTION 5.23 (1.00)

The reactor is critical at 10,000 cps when a Steam Generator PORV fails open. Assuming BOL conditions, no rod motion, and no reactor trip, choose the answer below that best describes the values of Tavg and nuclear power for the resulting new steady state. (POAH = point of adding heat).

a. Final Tavg greater than initial Tavg, Final power above POAH.

b. Final Tavg greater than initial Tavg, Final power at POAH.

c. Final Tavg less than initial Tavg, Final power at POAH.

d. Final Tavg less than initial Tavg, Final power above POAH.

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

QUESTION 6.01 (1.00)

What are the FOUR automatic close signals associated with the Orifice Isolation Stop Valves in the NV letdown system?

QUESTION 6.02 (1.50)

With the plant operating at 100% power, a malfunction causes a loss of 1EDA, 125 VDC distribution center. Would you expect the plant to trip? Briefly explain your answer.

QUESTION 6.03 (1.00)

Explain the response of a running feedwater pump if the steam header pressure input to the feedwater pump speed control fails low. Include why it responds this way.

QUESTION 6.04 (2.00)

While operating at 100% power, explain what the response of the S/G level control system will be if power range channel NI-41 fails low. Assume Unit 1 only and no protective actions occur.

QUESTION 6.05 (1.50)

Explain the system response AND protective actions that occur if, with power below 15%, the controlling level channel for S/G "C" fails high. Assume no operator action.

QUESTION 6.06 (1.00)

State the maximum KC system temperature, out of the ND heat exchanger, after the heat exchanger has been initially placed in service during a shutdown from full power.

QUESTION 6.07 (1.00)

With Train "A" VC-YC in operation, powered from Unit 1, a Safety Injection signal is received. Explain the response of the VC-YC system.

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

QUESTION 6.08 (1.00)

State how the VC-YC system will respond to a station blackout if NO trains were running prior to the blackout.

QUESTION 6.09 (2.00)

All four NCP motor feeder breakers automatically trip when the Reactor Coolant Pump Monitor senses under frequency. If this feature was not available, what would be the effect on the operation of the pump and what would be the safety analysis impact?

QUESTION 6.10 (1.00)

What supplies the backup motive force for the low pressure protection system should the Instrument Air System fail?

QUESTION 6.11 (1.00)

What indication would tell the operator that one of the central processing units in the Digital Rod Position system failed?

QUESTION 6.12 (1.00)

Explain why the Rod Control Urgent Failure reset pushbutton should not be depressed for > 1 second.

QUESTION 6.13 (2.00)

State the TWO specific parameters and associated values that will activate the C-16 interlock.

QUESTION 6.14 (1.00)

State the purpose of the flow orifice in the Cold Leg Accumulator (CLA) discharge line.

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

QUESTION 6.15 (2.00)

a. List FOUR Auxiliary Feedwater Pump suction water supplies.

b. List the FOUR Auxiliary Feedwater motor driven pumps' automatic start signals.

QUESTION 6.16 (1.00)

Explain what will happen if the sequencer reset button is depressed while sequencing is in progress during a blackout.

QUESTION 6.17 (1.00)

List the High-High S/G level setpoints for Feedwater Isolation, Turbine Trip (P-14 interlock) for Unit 1 and Unit 2.

QUESTION 6.18 (1.00)

The Standby Shutdown Facility contains systems designed to handle which of the following major events?

a. Rupture of dams impounding Lake Wylie and the service water pond.

b. A major fire disabling the Control Room controls and the Auxiliary Shutdown Panel controls.

c. The Control Room and the Technical Support Center are unavailable.

d. A LOCA that requires evacuation of the plant site for more than 2 hours.

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

QUESTION 6.19 (1.00)

Which of the following will cause the automatic closure of the UHI discharge isolation valves?

a. There is no automatic closure signal.

b. Low nitrogen pressure in the surge tank.

c. Low water level in the accumulator.

d. Membrane leakage alarm.

QUESTION 6.20 (1.00)

Which of the following statements concerning the operation of the Instrument Air (VI) system is NOT correct?

a. The BASE compressor runs continuously loading and unloading as necessary.

b. After an automatic start, the STBY 1 compressor will unload and stop after the BASE compressor is fully loaded and the 15 minute timer has timed out.

c. After an automatic start, the STBY 2 compressor must be manually stopped after the 15 minute timer has timed out.

d. At 76 psig VI header pressure, Station Air is supplied as a backup air supply.

QUESTION 6.21 (1.00)

With the Rod Control System in automatic, which of the following conditions would result in a rod withdrawal?

a. Nuclear power channel (N-44) fails high.

b. Tcold (Ch. A) detector fails low.

c. Impulse pressure (Ch. 1) fails high.

d. Tref fails low.

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

QUESTION 6.22 (1.00)

Which one of the following statements concerning OP delta T or OT delta T is correct?

a. The OP delta T instrument has a pressure input which provides DNB protection.

b. The OP delta T instrument has a pressure input which provides KW/FT protection.

c. The OT delta T instrument has a pressure input which provides DNB protection.

d. The OT delta T instrument has pressure input which provides KW/FT protection.

QUESTION 6.23 (1.00)

Which one of the following statements regarding Reactor Trip System Interlocks is true?

a. On increasing power, P-7 automatically enables reactor trips on low flow in one or more primary coolant loops, reactor coolant pump bus undervoltage and underfrequency, pressurizer high pressure and pressurizer low level.

b. On decreasing power, P-8 automatically blocks reactor trips on low flow in one primary coolant loop.

c. On power levels above P-9, reactor trip on turbine trip is automatically blocked.

d. On decreasing power, P-10 allows the manual block of the intermediate range reactor trip and automatically re-energizes the source range high voltage power.

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

QUESTION 6.24 (1.00)

Which one of the following statements regarding the Digital Rod Position Indication System is correct?

a. LED's indicate six step increments of rod position from the bottom.

b. There is one "general warning" (GW) LED per group at the top of the column to indicate a problem in position calculation.

c. A lighted number on a Central Control Unit (CCU) indicates a data cabinet error.

d. An urgent alarm, general warning and rod bottom LED flashing indicates that the central control unit has been automatically or manually disconnected from the system.

QUESTION 6.25 (1.00)

With 5 psig in containment, the KC system should be servicing which of the following?

a. Auxiliary Building Non-essential Header and the Essential Header.

b. Reactor Building Non-essential Header and the Essential Header.

c. The Reactor Building Non-essential Header

d. The Essential Header

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

QUESTION 7.01 (2.00)

According to EP/1/A/5000/1A1, Natural Circulation Cooldown Enclosure 1, there are the 5 characteristics of Natural Circulation. State any 4 of the 5.

QUESTION 7.02 (1.00)

Upon completion of a containment purge, what must be done concerning the trip setpoint of EMF 39?

QUESTION 7.03 (1.00)

In relation to the outlet of the S/G and the S/G components when the S/G's are in wet layup, where in the steam generator is level maintained? Explain why.

QUESTION 7.04 (1.00)

At what radiation level must an area in the Auxiliary Building be designated as a HIGH radiation area?

QUESTION 7.05 (1.00)

At what radiation level must an area in the Auxiliary Building be designated as a radiation area?

QUESTION 7.06 (1.00)

The Duke Power Co. administrative radiation limit for internal exposure is _____ MPC-hrs/wk, where a week is any period of 7 consecutive days.

QUESTION 7.07 (1.00)

What is your quarterly whole body radiation exposure administrative limit which you could receive without an approved extension?

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

QUESTION 7.08 (1.00)

State the name of the area controlled by the licensee for the purpose of radiation protection.

QUESTION 7.09 (1.00)

What are the operator's actions if, AFTER referring to a "Response Not Obtained (RNO)" action step, the expected RNO response cannot be satisfied?

QUESTION 7.10 (1.00)

Which one of the following critical safety functions lists is in decending order of priority?

a. Core Cooling, Heat Sink, Subcriticality, Containment, NC System Integrity, and NC Inventory.

b. Subcriticality, Core Cooling, Containment NC System Integrity, NC Inventiry, Heat Sink.

c. Subcriticality, Core Cooling, Heat Sink, NC System Integrity, Containment, NC Inventory.

d. Subcriticality, Core Cooling, NC System Integrity, Containment, and NC Inventory.

QUESTION 7.11 (1.00)

Which one of the following, according to EP/1/A/5000/2F3, "Voids in the Reactor", would allow the NC system to be repressurized to collapse a void?

a. If a LOCA does not exists.

b. If a S/G tube rupture exists.

c. If PTS limits would be exceeded.

d. If PZR heaters are inoperable.

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

QUESTION 7.12 (1.00)

State the subcooling requirement (amount) when cooling down on natural circulation with less than four CRDM fans operating.

QUESTION 7.13 (1.00)

What is the basis of the subcooling requirement when cooling down during natural circulation conditions?

QUESTION 7.14 (1.00)

Define an "ORANGE" color terminus on a critical safety function status tree as it relates to severity and operator response.

QUESTION 7.15 (1.00)

If all sources of water to the S/G's are unavailable, what method will be used to remove core decay heat?

QUESTION 7.16 (1.00)

During a normal startup, if criticality is achieved below the control rod position Tech Spec Limit, what actions must the operator take?

QUESTION 7.17 (1.00)

When the reactor is shutdown, what must be done before positive reactivity can be added by boron dilution?

QUESTION 7.18 (1.00)

How does the operator control feed flow to the S/G's at the SSF control board?

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

QUESTION 7.19 (1.00)

Why is it necessary to isolate leakage into containment that is causing sump level to rise greater than 13 feet, as stated in EP/1/A/5000/2E2, "High Containment Sump Level"?

QUESTION 7.20 (1.00)

Why is the operator warned NOT to operate the Containment Hydrogen (H2) purge system in OP/1/A/6450/10, "Containment H2 Control", when containment H2 concentration is < 3%?

QUESTION 7.21 (1.00)

A reactor coolant pump should not be started unless the No. 1 seal delta P is greater than...

a. 100 psi.

b. 200 psi.

c. 300 psi.

d. 400 psi.

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

QUESTION 7.22 (1.00)

Which of the following statements is correct concerning the status of the Nuclear Instrumentation Recorder prior to withdrawing control bank rods for a reactor startup?

a. The highest reading source range channel and the highest reading intermediate range channel is selected and the NR-45 chart speed is set to "Hi" speed.

b. The highest reading source range channel and the highest reading intermediate range channel is selected and the NR-45 chart speed is set to "Lo" speed.

c. The highest reading source range channel and the lowest reading intermediate range channel is selected and the NR-45 chart speed is set to "Hi" speed.

d. The highest reading source range channel and the lowest reading intermediate range channel is selected and the NR-45 chart speed is set to "Lo" speed.

QUESTION 7.23 (1.00)

The transfer of control of the pressurizer heaters (sub-bank of Group D) to the Safe Shutdown Facility (SSF) is performed by:

a. swapping power supplies of the motor control centers from normal to alternate in the ETA rooms.

b. swapping a plug type connector from the normal connection to the alternate connection in the SSF.

c. placing the Pressurizer Heater Selector Switch in the main control room to the "Remote-SSF" position.

d. placing the Pressurizer Heater Selector Switch in the SSF to the "Local" position.

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

QUESTION 7.24 (1.00)

KC flow through the NCP seal water heat exchanger is assured by verifying:

a. proper flow indication.

b. proper pressure indication.

c. at least one KC pump is operating.

d. no seal water heat exchanger KC Hi/Lo flow alarm condition exists.

QUESTION 7.25 (1.00)

While operating Unit 1 at 85% power, an inadvertent boron dilution occurs which results in a "Control Rod Bank Lo-Lo Limit" alarm. Which of the following is an appropriate immediate operator action in accordance with AP/1/A/5500/13, "Boron Dilution"?

a. Emergency borate to clear the "Control Bank Lo Limit" alarm.

b. Emergency borate to clear the "Control Rod Bank Lo-Lo Limit" alarm.

c. Stop the source of the dilution and obtain a chemistry sample to determine the required boration.

d. Stop the dilution process and emergency borate to raise the rods to the position they occupied prior to the inadvertent dilution.

QUESTION 7.26 (1.00)

AP/1/A/5500/04, "Loss of Reactor Coolant Pumps", contains a CAUTION that states that reactor power should be reduced to below a certain power level prior to restarting the affected NC pump(s). Which of the following is this power level?

a. 45%

b. 35%

c. 25%

d. 15%

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

QUESTION 7.27 (1.00)

During a reactor coolant leak identification process, which of the following gives the requirement for shifting the operating centrifugal charging pump suction from the VCT to the FWST?

a. Pressurizer level decreases to 17%.

b. VCT level decreases to 20%.

c. Letdown isolated and pressurizer level decreasing.

d. Prior to stating a second centrifugal charging pump.

QUESTION 7.28 (1.00)

If KC and NV seal cooling for any NC pump is lost, within how many minutes AND from where must seal injection flow be initiated?

QUESTION 7.29 (1.00)

Multiple Choice.

When an individual has received _____ of an administrative radiation exposure limit, he/she must inform his/her supervisor.

a. 75%

b. 80%

c. 85%

d. 90%

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

QUESTION 8.01 (1.00)

State the basis for the Tech Spec limit on S/G activity.

QUESTION 8.02 (1.00)

Define or provide the general event symptoms of a "site area emergency" as referenced in your response procedures.

QUESTION 8.03 (1.00)

What TWO individuals, by title, may fill the role of Emergency Coordinator?

QUESTION 8.04 (1.00)

Who must approve the Emergency Notification Message Form to allow information to be transmitted to offsite agencies?

QUESTION 8.05 (2.00)

a. What action must be done to satisfy Tech Spec requirements if Quadrant Power Tilt Ratio exceeds 1.02 but is less than 1.09?

b. This action must continue until one of two conditions is met. State the TWO conditions.

QUESTION 8.06 (2.00)

One full length rod is tripable but inoperable due to causes OTHER THAN friction or mechanical binding.

According to Tech Spec Section 3.1.3, THREE options are available, one of which must be done within one hour. State the THREE one hour options. (Do not include any options, or parts of options, that have time requirements greater than one hour).

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

QUESTION 8.07 (2.00)

A turnover sheet is NOT required for short term shift relief during shift if THREE conditions are met. State the THREE conditions.

QUESTION 8.08 (1.00)

In the event a member of the shift crew is incapacitated, the shift crew composition, with the exception of the Shift Supervisor, for each unit, may be _____ less than the minimum requirements for a period not to exceed _____ hour(s).

a. 2, 2

b. 1, 1

c. 2, 1

d. 1, 2

QUESTION 8.09 (1.00)

According to station directives, what documentation is required when a Safety Tag violation is reported?

QUESTION 8.10 (1.00)

If safety tags need to be removed for testing, what is the maximum time that tags may be lifted?

QUESTION 8.11 (1.00)

During plant operations, who (by title) controls access to the Control Room ~~access~~ during

a) Normal conditions?
b) Emergency conditions?

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

QUESTION 8.12 (1.00)

According to Station Directive 3.1.15, "Activities Affecting Station Operations or Indications", who's permission (by title) is required prior to removal of an instrument or component ~~form~~ from service?

QUESTION 8.13 (1.00)

While operating in MODE 3, a piece of equipment becomes inoperable and is not covered by the applicable action statement. Tech. Spec. requires that 3.0.3 be applied. In this case, how long do you have to place the plant in Cold Shutdown?

QUESTION 8.14 (2.00)

State the requirements that must be met in order to deviate from an approved procedure.

QUESTION 8.15 (1.00)

When is a procedure not required to be in the possession of the user?

QUESTION 8.16 (1.00)

State TWO requirements that must be met before a person may enter a space containing a high pressure steam relief device during Mode 1.

QUESTION 8.17 (1.00)

Which one of the below leakages occurs when the pressure within the incore instrument guide tube causes the high pressure seal at the seal table to burst?

a. Unidentified

b. Pressure isolation valve

c. Identified

d. Pressure boundary

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

QUESTION 8.18 (1.00)

One of two actions are required when one Cold Leg Accumulator is inoperable in Mode 1 due to the discharge isolation valve being closed?
What are the TWO actions?

QUESTION 8.19 (1.00)

What is the basis for the Tech Spec limit of 363,513 gallons of water volume in the FWST during Modes 1-4?

QUESTION 8.20 (1.00)

What is the lowest Emergency Classification Level at which the Technical Support Center is activated?

QUESTION 8.21 (1.00)

At what Emergency Classification Level is evacuation of non-essential personnel MANDATORY?

QUESTION 8.22 (1.00)

If the reactor coolant system pressure exceeds 2735 psig when in Mode 3, Technical Specifications requires the pressure to be reduced to within the limit within:

a. 5 minutes.

b. 15 minutes.

c. 30 minutes.

d. one hour.

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

QUESTION 8.23 (1.00)

If control power is lost to a pressurizer power operated relief valve while in Mode 1...

a. no action is required by Tech Specs provided another PORV is operable and all pressurizer code safety valves are operable.

b. Tech Specs require the the power supply to be removed from the associated block valve after verifying it to be open, if the PORV is not made operable within one hour and continuous operation is desirable.

c. Tech Specs require the associated block valve to be shut and its power removed if the PORV is not made operable within one hour and continuous operation is desirable.

d. Tech Specs require action to be initiated within one hour to place the plant in at least HOT STANDBY within the following hour if the PORV is not made operable.

QUESTION 8.24 (1.00)

Multiple Choice.

A quarterly surveillance requirement of Tech Specs may be extended an additional _____ days without declaring the component inoperable due to the surveillance testing not being performed.

a. 9

b. 23

c. 32

d. 41

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

QUESTION 8.25 (1.00)

When transferring initials from a performed part of a procedure to a retype of the procedure, the signature required indicating the initials have been transferred is that of...

a. the operator initialling the original procedure.

b. a supervisor.

c. any on shift licensed operator.

d. any on shift SRO licensed operator, but not an RO licensed operator.

QUESTION 8.26 (1.00)

During a Site Area Emergency, which of the following will search for unaccounted personnel?

a. the responsible supervisor.

b. Health Physics.

c. the Fire Brigade.

d. Security.

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

EQUATION SHEET

$f = ma$

$w = mg$

$E = mC^2$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$W = v\Delta P$

$\Delta E = 931\Delta m$

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

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

$Pwr = W_f \dot{m}$

$P = P_o\ 10^{SUR(t)}$

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

$SUR = 26.06/T$

$T = 1.44\ DT$

$SUR = 26\left(\frac{\lambda_{eff}\rho}{\bar{\beta} - \rho}\right)$

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

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

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

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

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

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

$\Sigma = N\sigma$

$v = s/t$

$s = v_o t + \frac{1}{2}at^2$

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

Cycle efficiency = $\frac{\text{Net Work (out)}}{\text{Energy (in)}}$

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

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

$t_{\frac{1}{2}}(eff) = \frac{(t_{\frac{1}{2}})(t_b)}{(t_{\frac{1}{2}} + t_b)}$

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

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

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

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

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

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

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$M = (1 - K_{eff})_0/(1 - K_{eff})_1$

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

$\ell^* = 1 \times 10^{-5}$ seconds

$\lambda_{eff} = 0.1$ 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)

$R/hr = 6\ CE/d^2$(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 Btu = 778 ft-lbf

1 inch = 2.54 cm

$^\circ F = 9/5\,^\circ C + 32$

$^\circ C = 5/9\ (^\circ F - 32)$

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 5.01 (1.00)

a.

REFERENCE
V. C. Summer Reactor Theory, I-5.80
HBR RXTH-HO-1 Session 23 p. 3
CNS, OP-CN-HO-RK, pp 10-12

ANSWER 5.02 (1.00)

b

REFERENCE
Westinghouse Reactor Physics, pp. I-5.26 & 27
HBR RXTH-HO-1 Session 32 pp. 3, 4
CNS, OP-CN-RCO-HO, pp 12 & 13

ANSWER 5.03 (2.00)

1. Clad creep.
2. Plutonium 240 buildup.
3. Fission gas buildup.
4. Fuel densification.

REFERENCE
CNS, OP-CN-RCO-HO, pp 10-11

ANSWER 5.04 (1.00)

b

REFERENCE
CNS, CNS Exam Bank.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 5.05 (1.00)

b.

REFERENCE
WBN, TS, p. B 3/4 1-1
HBR, TS, p. 3.10-10
CNS, TS, p. B 3/4 1-1
NAPS, TS, p. B 3/4 1-1

ANSWER 5.06 (1.00)

1. neutron source present
2. fissionable fuel present [0.5 each]

REFERENCE
CNS, OP-CN-HO-SCM, p. 3

ANSWER 5.07 (1.00)

d.

REFERENCE
Westinghouse Reactor Physics, pp. I-5.63-76.
HBR, Reactor Theory, Sessions 38 and 39.
DPC, Fundamentals of Nuclear Reactor Engineering, Section VI.
CNS, CN-OP-RP-HO, pp 3-9

ANSWER 5.08 (1.50)

a. Rod worth increases from the outside edge to the middle. or (The higher flux regions have higher rod worth)

b. Rod worth decreases.

c. Rod worth increases.

REFERENCE
Catawba Question Bank
HBR RXTH-HO-1 Session 35 pp. 2-7

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 5.09 (1.00)

d

REFERENCE
Steam Tables

ANSWER 5.10 (1.00)

d

REFERENCE
MNS OP-SS-HT-2, p.12.
Westinghouse Thermal-Hydraulic Principles and Applications to PWR II Chapter 7
CNS Exam Bank

ANSWER 5.11 (1.50)

a. REMAIN THE SAME
b. DECREASE
c. INCREASE

REFERENCE
Steam Tables

ANSWER 5.12 (1.00)

Temperature.

REFERENCE
CNS, EXAM BANK

ANSWER 5.13 (2.00)

a. increase
b. decrease
c. decrease
d. increase

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

REFERENCE
CNS, OP-CN-FF-HO, pp 4-8

ANSWER 5.14 (1.50)

a. Peaking Factor (0.3)

b. Increase. (0.3)

c. Does not assure. (0.3)

d. Not uniform, [0.3] The same [0.3] (0.6)

REFERENCE
HBR GP HTFF pp. 193-198
Thermal-Hydraulic Principles, Pp. 13- 30 thru 36
CNS Exam Bank

ANSWER 5.15 (1.00)

1. It increases the total heat transfer coefficent (agitation) (by mixing the boundary layer). (Better heat transfer because of the bubbles leaving the cladding and breaking up the boundry/film layer.) [0.5]

REFERENCE
CNS, OP-CN-THF-HT-HO, p. 6, Pg 306.
Westinghouse Thermo, p. 68.

2. There is an increase in heat transfer rate because of the heat transferred by way of forming the bubbles; i.e. latent heat of vaporization [0.5]

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 5.16 (1.00)

[-.1 for each math error]
To determine flow:

At 100% power:

$$Q = \dot{m}\, cp\, \Delta T \Rightarrow 100 = 100 * cp * 42 \Rightarrow cp = \frac{100}{100 * 42}$$

At decay heat:

$$2\% = \dot{m} * Cp * 28 \Rightarrow Cp = \frac{2}{\dot{m} * 28}$$

THEN: $\frac{1}{42} = \frac{2}{\dot{m}\ 28}$ AND; $\dot{m} = \frac{2\% * 42}{28} = 3.0\%$

REFERENCE

General Physics, HT & FF, Section 3.2
ROWE Reactor Operator Training Manual, Sec. 2, pp 54-63
Westinghouse Thermal-Hydraulic Principles and Applications to PWR II
Chapter 14, pp 15-29
CNS, OP-CN-THF-HT-HO, pp 1-2

ANSWER 5.17 (2.00)

a. power decreases. [1.0]

b. 1. overload (overheat) of motor (trip of the motor breaker.)
2. cavitation ~~[0.5 each]~~
3. Pump efficiency decreases
4. Overheating of pump (bearings). [any 2 at .5 each]

REFERENCE
CNS, OP-CN-FF-HO, pp 6-8
OP-CN-THF-FF. p. 16

ANSWER 5.18 (1.00)

444 GPM
25 PSI (24.64)
55 KW (54.71)

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

REFERENCE
CNS, OP-CN-FF-HO, pp 4-6

ANSWER 5.19 (1.50)

a. 3. (same)

b. 1. (ACP higher)

c. 2. (ACP lower) [0.5 ea.]

REFERENCE
SQNP, Review of Core Poisons, pp. 4 - 7 KA001/000,K5.18,4.2.
Cook Theory, Pp. I-36-45.
Zion, NUS book 3, section 12.5.
CNS, CN-OP-RP-HO, p. 4
OP-CN-RCO-HO, pp 4-8

ANSWER 5.20 (2.00)

a. 36 seconds. (+/- 2) [1.0]

b. No.[.25] Power escallation is a log function and therefore increases at an increaseing rate. [.75]
Credit will be given if candidate provides log formula, or calculates the time to be shorter.

REFERENCE KA001/010,K5.37,3.2.
Cook Theory, Pp. I3.15-16.
Zion, NUS book 3, section 6.4
CNS, OP-CN-HO-RK, pp 3-7

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 5.21 (1.50)

a. MORE NEGATIVE [0.25] because rods are inserted and push the flux to the bottom of the core [0.25]

b. MORE NEGATIVE [0.25] because more moderation will occur in the bottom of the core (due to T-cold decreasing) [0.25]

c. LESS NEGATIVE [0.25] because Xe inserts MORE negative reactivity in the bottom of the core ~~and~~ than in the top of the core. [0.25]

REFERENCE
Rx Th pgs. 196-210, 232-233
TS pgs. 1-1 and B 3/4 2-1

3.1 001 000 K 5.06 3.8
K 5.38 3.5

ANSWER 5.22 (1.50)

a. (1) Increasing towards peak Xenon concentration.

b. (4) Decreasing toward zero percent power equilibrium value.

c. (3) Decreasing toward a dip. [0.5 ea.]

REFERENCE
HBR Reactor Theory Rxth-Ho-1 Session 39 pp. 3-8
CNS, OP-CN-RCO-HO, pp 2-8

ANSWER 5.23 (1.00)

d.

REFERENCE
Westinghouse Reactor Physics, Section I-5, MTC and Power Defect
DPC, Fundamentals of Nuclear Reactor Engineering
HBR RXTH-HO-1 Session 48 pp. 3-8
CNS, OP-CN-RCO-HO, pp 2-8
002/000-K5.02 (3.3/3.6)

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 6.01 (1.00)

1. Low PZR Level
2. Cntmt. Isolation (ST)
3. L/D isolation valves (NV 1&2) go shut
4. All 3 charging pumps tripped.

REFERENCE
CNS OP-CN-HO-NV; P. 8

ANSWER 6.02 (1.50)

Yes [0.5], Feedwater Isolation ~~and~~ (Main Steam Isolation) would occur causing the plant to trip on S/G level [1.0].

REFERENCE
CAT,OP-CN-HO-EPL, p.7 and CNS Exam Bank Question Number Q-EL-EPL-18.

ANSWER 6.03 (1.00)

Indicated D/P becomes larger than programmed D/P [0.5], so the feedwater pump slows down [0.5].

REFERENCE
CAT, OP-CN-IWE-HO, pp. 6,7.

ANSWER 6.04 (2.00)

on S/G A & D only.

On Channel I: Reference will adjust to 38%. [.5] S/G's A & D
If Channel I is controlling, ~~all~~ levels in ~~the generators~~ will change accordingly. [.5]
Low Level alert will adjust to 22%. [.5]
Lo-Lo Level trip will adjust to 17% [.5]

in one channel → in all 4 S/G's

REFERENCE
CAT, CN-OP-HO-IFE, p. 2.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 6.05 (1.50)

- False high signal will close the FRV bypass [0.5]
- Level will drop in S/G "C" [0.5]
- A Lo-Lo level reactor trip will occur [0.5]

REFERENCE
CAT, OP-CN-HO-IFE, p. 5.

ANSWER 6.06 (1.00)

120 F (115 - 125)

REFERENCE
CAT, OP-CN-HO-ND, p. 4.

ANSWER 6.07 (1.00)

Train "A" will remain running and Train "B" CR-AHU and pressure filter fan will start.

REFERENCE
CAT, OP-CN-HO-VC, p. 11.

ANSWER 6.08 (1.00)

The train that receives the start signal first will start and run.

REFERENCE
CAT, OP-CN-HO-VC, p. 11.

ANSWER 6.09 (2.00)

The pump would undergo rapid deceleration caused by the decaying frequency [1.0]. This would significantly reduce flow due to the loss of the inertia provided by the flywheel (coastdown would be eliminated). [1.0]

REFERENCE
CAT, OP-CN-HO-NCP, p. 25 and CNS Exam Bank Question Number Q-CM-NCP-06.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 6.10 (1.00)

Nitrogen from the Cold Leg Accumulators A and B.

REFERENCE
CAT, OP-CN-HO-VI, p. 7.

ANSWER 6.11 (1.00)

Associated CCU light lit.

REFERENCE
CAT, OP-CN-HO-EDA, p. 7.

ANSWER 6.12 (1.00)

To prevent overheating of the CRDM coils.

REFERENCE
CAT, OP-CN-HO-IRE, p. 18.

ANSWER 6.13 (2.00)

1. Tave drops below 553 F [1.0]
2. Tave >20 F below Tref [1.0]

REFERENCE
CAT, OP-CN-HO-IPX, p. 14 and CNS Exam Question Bank Number Q-IC-IPE-04.

ANSWER 6.14 (1.00)

To extend the blowdown time of the Cold Leg Accumulators during a loss of coolant accident.
(also accept: Prevent accumulator blowdown directly out the leak to the sump during a LOCA AND allows CLA water to be available for the reflood phase.)

REFERENCE
CAT, OP-CN-HO-CLA, p. 4.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 6.15 (2.00)

a. 1. UST. (upper surge tank)
2. CA Condenser Storage Tank.
3. Condensate Hotwell.
4. Nuclear Service Water.
5. RC. (RN) [any 4 at .25 each]

b. 1. Low low level in any SG.
2. Trip of both main feedwater pumps.
3. Ss signal.
4. Blackout signal. (2/3 UV relays on the essential bus) [any 4 at .25 ea.]

REFERENCE
MNS OP-MC-SPS-SY-CA, p.8.
CNS CA Lesson Plan, p.7, p.8.

ANSWER 6.16 (1.00)

No futher load groups will be applied.

REFERENCE
MNS EDG Load Seq. Lesson Plan, p.14.
CNS PSM CN-SYS-EQB.

ANSWER 6.17 (1.00)

Unit 1: 82.4%. (82)
Unit 2: 78%. [.5 each]

REFERENCE
CNS PSM CN-CMP-SG, p.1.

ANSWER 6.18 (1.00)

b

REFERENCE
CAT, CNCS-0144-02, p. 2

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 6.19 (1.00)

c

REFERENCE
CAT, CN-PSM-SY-UHI, p. 1

ANSWER 6.20 (1.00)

c

REFERENCE
CAT, CN-PSM-SY-VI, p. 2

ANSWER 6.21 (1.00)

c

REFERENCE
WBN, LP - Rod Control System, pp. 8 & 14
CAT, PSM, Figures CN-IC-IRE-21 and 22.

ANSWER 6.22 (1.00)

c.

REFERENCE
CAT, OP-CN-HO-IPX, pp. 6 and 7.

ANSWER 6.23 (1.00)

b.

REFERENCE
CAT, OP-CN-HO-IPX, pp. 12 and 13.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 6.24 (1.00)

a.

REFERENCE
CAT, OP-CN-HO-EDA, p. 2.

ANSWER 6.25 (1.00)

d.

REFERENCE
CAT, OP-CN-HO-KC, pp. 8 and 9.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 7.01 (2.00)

- NC subcooling: > 0 F
- S/G Pressures: Stable or Decreasing
- NC Thot: Stable or Decreasing
- Core Exit T/C: Stable or Decreasing
- Nc Tcold: Near saturation temperature for S/G pressure

[any 4 at .5 each]

REFERENCE
CAT, EP/1/A/5000/1A1, Encl. 1

ANSWER 7.02 (1.00)

Put back (reset) to previous setpoint, or take sample and calculate new setpoint.

REFERENCE
CAT, CNS Exam Question Bank Number Q-SY-UP-19.

ANSWER 7.03 (1.00)

Between four feet below the outlet nozzles [.25] and one foot above the seperators [0.25] to protect the steam line pipe hangers [0.5].

REFERENCE
CAT, OP/1/A/6250/03A, and CNS Exam Question Number Q-STM-SG-12.

ANSWER 7.04 (1.00)

> 100 mrem/hr

REFERENCE
CAT, OP-CN-HO-HPM, P. 20.

ANSWER 7.05 (1.00)

$\geq \frac{5}{2}$ mrem/hr

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

REFERENCE
CAT, ~~OP-CN-HO-HPM, p. 20.~~
~~HP~~/0/8/1000/05, p.3

ANSWER 7.06 (1.00)

~~30~~ 35

REFERENCE
CAT, OP-CN-HO-HPM, p. 7.

ANSWER 7.07 (1.00)

~~1000~~ Millirem 90% [.5] of 1000 mrem/qtr [.5] OR 90% [.5] of 2500 mrem/yr [.5]

REFERENCE
CAT, ~~OP-CN-HO-HPM, p. 2.~~
CNS DIRECTIVE 3.8.6, p. 3.

ANSWER 7.08 (1.00)

Restricted Area

REFERENCE
CAT, OP-CN-HO-HPM, P. 18.

ANSWER 7.09 (1.00)

Goes on with the procedure [.5] while still attempting the RNO action. [.5]

REFERENCE
CAT, CNS Exam Question Bank Number Q-EP-EP1-51.

ANSWER 7.10 (1.00)

c.

REFERENCE
CAT, EP/1/A/5000/02, p.3.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 7.11 (1.00)

a.

REFERENCE
CAT, EP/1/A/5000/2F3, p. 4.

ANSWER 7.12 (1.00)

Greater than [.25] 100 F subcooling. [.75]

REFERENCE
CAT, EP/1/A/5000/1A1, p. 5.

ANSWER 7.13 (1.00)

To prevent void formation in the upper head region of the reactor vessel due to insufficient cooling of the head.

REFERENCE
CAT, CNS Exam Question Bank Number Q-EP-CSF-1-12.

ANSWER 7.14 (1.00)

A safety function under severe challenge [.5] with prompt operator action required. [.5]

REFERENCE
CAT, EP/1/A/5000/02, p.2.

ANSWER 7.15 (1.00)

Safety injection flow [.5] with open PRZ PORV's. [.5]

REFERENCE
CAT, EP/1/A/5000/2C1, p.11.

also accepted:
Feed and Bleed of the NCS

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 7.16 (1.00)

Initiate boration at >/= 30 gpm of 7000 ppm boron and withdraw rods to maintain criticality until they are above the limit.

REFERENCE
CAT, OP/1/A/6000/01, p. 14.

ANSWER 7.17 (1.00)

All shutdown banks must be fully withdrawn.

REFERENCE
CAT, OP/1/A/6000/01, p. 2.

ANSWER 7.18 (1.00)

Starting/Stopping the CAPT via the T & T valve.

REFERENCE
CAT, OP/0/B/6100/13 and CNS Exam Question Bank Number Q-CP-AD-05.

ANSWER 7.19 (1.00)

To prevent equipment damage (position indication of some valves may be erroneous.) and dilution of sump water.

REFERENCE
CAT, EP/1/A/5000/2E2, p. 1.

ANSWER 7.20 (1.00)

To prevent overloading the annulus ventilation filters.

REFERENCE
CAT, OP/1/A/6450/10, p. 1.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 7.21 (1.00)

b

REFERENCE
MNS OP/1/A/6150/02A, p. 1.
CNS OP/1/A/6100/01, Encl. 4.1,2.17.

ANSWER 7.22 (1.00)

a

REFERENCE
MNS OP/1/A/6100/01, pp.14-15.
CNS OP/1/A/6100/01, Encl. 4.1, 2.70 and 2.75.

ANSWER 7.23 (1.00)

d

REFERENCE
MNS OP/0/A/6100/17, Encl. 4.1, p.5.

ANSWER 7.24 (1.00)

d

REFERENCE
CNS OP/1/A/6200/01, Encl 4.1, 2.8.1.

ANSWER 7.25 (1.00)

b

REFERENCE
CAT, AP/1/A/5500/13, p. 2

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 7.26 (1.00)

c

REFERENCE
CAT, AP/1/A/5500/04, p. 4

ANSWER 7.27 (1.00)

d

REFERENCE
CNS AP/1/A/5500/10, p.2.

ANSWER 7.28 (1.00)

1. 10 minutes (0.5)
2. From the SSF (0.5)

REFERENCE
CAT, AP/1/A/5500/08, p. 2.

ANSWER 7.29 (1.00)

b

REFERENCE
CNS Directive 3.8.6, p.2.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 8.01 (1.00)

~~25 Rem within 2 hours at the exclusion area boundary with a S/G rupture.~~ Ensures that the resultant offsite radiation dose will be limited to a small fraction of 10 CFR 100 values in the event of a steamline rupture.

REFERENCE
CAT, T.S. p. ~~B 3/4 4-5.~~ B 3/4 7-2

ANSWER 8.02 (1.00)

(Events are in progress or have occurred which involve) actual or likely major failures of plant functions needed for protection of the public.

REFERENCE
CAT, RP/0/A/5000/04, p. 1.

ANSWER 8.03 (1.00)

Station Manager and Shift Supervisor.

REFERENCE
CAT, SD 3.8.4 and CNS Exam Question Bank Number Q-EP-SEP-08.

ANSWER 8.04 (1.00)

Emergency Coordinator.

REFERENCE
CAT, RP/0/A/5000/02, p. 1.

ANSWER 8.05 (2.00)

a. 1. Calculate QPTR every hour. [1] 2. Within 2 hours restore QPTR or reduce power 3% for every 1% QPTR violation. [1]

b. 1. Until QPTR is within limits [0.5]

2. Until power is ~~< 50% of rated power~~ reduced to within T.S. limits. [0.5]

REFERENCE
CAT, Tech. Spec. Section 3.2.4

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 8.06 (2.00)

1. Restore the rod. [0.5]
2. Realign the rest of the bank to plus or minus 12 steps of the inoperable rod [0.5], maintaining rod sequence and RIL's [0.5].
3. Calculate a SDM. [0.5]

REFERENCE
CAT, Tech Spec Section 3.1.3

ANSWER 8.07 (2.00)

1. Person relieving is qualified. [0.667]
2. Person relieving has participated in on-shift activities and is aware of conditions. [0.667]
3. A verbal update is given to the person relieving by the person being relieved. [0.667]

REFERENCE
CAT, OMP 2-22, p. 3.

ANSWER 8.08 (1.00)

d.

REFERENCE
CAT, T. S. Section 6, Table 6.2-1.

ANSWER 8.09 (1.00)

Tag Occurrence Report Form

REFERENCE
CAT, SD 3.1.1, p. 4.

ANSWER 8.10 (1.00)

24 hours

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

REFERENCE
CAT, SD 3.1.1, P. 11.

ANSWER 8.11 (1.00)

a) OATC [.5]
b) Shift Supervisor (or designee) [.5]

REFERENCE
CAT, OMP 2-16, p. 3.
CNS station Directive 3.1.10, p. 2.

ANSWER 8.12 (1.00)

1. Shift Supervisor 2. Asst. Shift Supervisor 3. Supervisor with Operational Control (any one full credit.)

REFERENCE
CAT, SD 3.1.15. p. 2.

ANSWER 8.13 (1.00)

31 hours (-.25 if do not account for 1 hour to take action)

REFERENCE
CAT, T.S. Section 3.03.

ANSWER 8.14 (2.00)

If intent of procedures is to be deviated from, no allowed without an approved
1. ~~Requires that there be~~ no deviation ~~from the intent of the~~ procedure. ~~[1.0]~~ change [1.0]
2. Verbal approvals ~~of two operators~~ one of whom is a supervisor who holds a SRO license. [1.0] is needed for temporary approval of procedure change with no intent change.

REFERENCE
CAT, CNS Exam Question Bank Number Q-ADM-OP-08. OMP 1-4
3. In an emergency, the licensed Operator may deviate from procedure to protect the safety of the public. [any one of the 3 for full credit].

ANSWER 8.15 (1.00)

When "Possession N/R" is indicated.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

REFERENCE
CAT, OMP 1-4, p. 7.

ANSWER 8.16 (1.00)

He must notify the Shift Supervisor and use the "Buddy System".

REFERENCE
CAT, Station Directives 2.11.12

ANSWER 8.17 (1.00)

~~a~~ c.

REFERENCE
CAT, T.S. ~~Section 3.4.6.2~~. Definitions. p 1-3 ; 4.

ANSWER 8.18 (1.00)

1. Open the valve immediately [.5] ^ OR 2. Be in at least hot standby within 6 hours. [.5]

REFERENCE
CAT, T.S. Section 3.5.1.

ANSWER 8.19 (1 00)

It ensures sufficient water is available within containment to permit recirculation cooling flow to the core.

REFERENCE
CAT, T.S. Basis p. B3 5-2.

ANSWER 8.20 (1.00)

Alert

REFERENCE
CAT, RP/0/A/5000/03, p. 1.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 8.21 (1.00)

General Emergency

REFERENCE
CAT, RP/0/A/5000/05, p. 1.

ANSWER 8.22 (1.00)

a

REFERENCE
MNS TS, 2.1.2.
CNS TS, 2.1.2.

ANSWER 8.23 (1.00)

c

REFERENCE
MNS TS, 3.4.4.
CNS TS, 3.4.4.

ANSWER 8.24 (1.00)

b

REFERENCE
MNS TS, 4.0.2 & 4.0.5.
CNS TS, 4.0.2.

ANSWER 8.25 (1.00)

b

REFERENCE
CNS OMP 1-4, p.9.

ANSWERS -- CATAWBA 1 -86/09/01-HEMMING, W.

ANSWER 8.26 (1.00)

d

REFERENCE
CNS Directive 3.0.7, p.2.

ENCLOSURE 3

NRC RO EXAM 9-2 COMMENTS

SECTION 1.0

1.15 Should accept "by carrying away latent heat of vaporization" See reference 1.15.

1.17 b. Accept as possible answers also

1. Pump efficiency
2. Eventual flow loss
3. Overhead motor and/or pump

See Reference 1.17

1.20 b. For an explanation should give credit for using formula to work the calculation thus proving it.

SECTION 2.0

2.08 b.2 Also give ph proper in the sump.
See Reference 2.08.

2.11 Also accept

10. EMF53A
11. EMF53B
12. Containment H_2 concentration

See Reference 2.11

2.12 a. 1. Setpoints should not be required.
Valve numbers should not be required

c. Setpoints should not be required

2.13 c. Load rejection controller will arm and dump ~ 35% steam flow through the condenser dumps. S/G PORV;s and safeties will account for other ~ 40% flow. TAve will cool to within 3°F of Tref or ~ 560°G.
See Reference 2.13

2.15 Feed Isolation or Steam Isolation will have the same affect. Either should be acceptable.
No Reference needed.

2.20 Smoke detection will not cause CO_2 actuation.
See Reference 2.20

SECTION 3.0

3.01 Accept B or C
See Reference 3.01

3.02 Accept for B. Unit 1 or Both.
See Reference 3.02

3.08 d. The correct answer for C-16 setpoint is the answer to SRO Question 6.13

3.09 b. Defeats input power range to auctioneering circuit for Rod Control and S/G Feed Reg Bypass Valve.
See Reference 3.09

3.10 c. Since level error signal overcomes the flow error, after 15 minutes the level could be lower or it could be the same.

3.11 b. Should except a band of ± 2%.

3.12 a. Should also accept 1) Mechanical Overspeed and 2) Local or Manual Trip Handle.
See Reference 3.12

3.15 Should be 20%/min.
See Reference 3.15

SECTION 4.0

4.02 Should accept S/B makeup pump

4.06 b. Should accept 5 or 2 See Reference 4.06

4.08 Should be 105 gpm instead of 150.
See Reference 4.08

4.13 Should accept CR operator also.
See Reference 4.13

REFERENCE 1.15

The process of subcooled nucleate boiling is shown pictorially in Figure FND-HT-28. As the bulk fluid flows over the high temperature water trapped in the nucleation sites, the pressure in the volume of the imperfection is lowered (Figure FND-HT-28a). The liquid coolant trapped in the cavity at a reduced pressure and high temperature forms a tiny steam bubble by absorbing the required latent heat of vaporization from the fuel rod. Since the latent heat of vaporization is larger than the heat energy required to raise the temperature of the subcooled liquid, heat is transferred out of the fuel rod at a faster rate. The temperature of the fuel rod surface in the area of the nucleation site decreases. The formation of the steam bubble, as Figure FND-HT-28b indicates, increases the pressure inside the cavity. As heat transfer from the fuel rod continues, pressure increases further, and the steam bubble expands (Figure FND-HT-28c). The expanding bubble pushes the hot liquid near the surface of the fuel rod away from the rod (Figure FND-HT-28d). Eventually, the increasing pressure overcomes the surface tension of the liquid surrounding the bubble and the bubble is swept into the turbulent region by the moving laminar layers. The colder water in the bulk fluid rushes into the nucleation cavity and the region of the rod surface previously covered by the steam bubble (Figure FND-HT-28e). The in-rush of cooler liquid from the bulk fluid causes a rapid transfer of heat from the fuel rod to the incoming cooler water. The temperature of the fuel rod drops, returning to subcooled temperatures. The heat energy conducted to the fuel rod surface from inside the fuel reheats the surface to begin the cycle again (Figure FND-HT-28f).[7]

As the tiny steam bubbles are swept away from the fuel rod surface, the bubbles cause turbulence within the laminar region. This turbulence reduces the thickness of the laminar layer, thereby increasing the convective heat transfer coefficient. When the bubbles enter the main flow of bulk liquid, they immediately condense and become liquid molecules at the same temperature as the

film which covers the surface. The heat must be conducted through this film before it can reach the liquid and effect the boiling process. The thermal resistance of this film causes a reduction in heat flux, and this phenomenon is illustrated in region IV, the *film-boiling* region. This region represents a transition from nucleate boiling to film boiling and is unstable. Stable film boiling is eventually encountered in region V. The surface temperatures required to maintain stable film boiling are high, and once this condition is attained, a significant portion of the heat lost by the surface may be the result of thermal radiation, as indicated in region VI.

An electrically heated wire is unstable at point a since a small increase in ΔT_x at this point results in a decrease in the boiling heat flux. But the wire still must dissipate the same heat flux, or its temperature will rise, resulting in operation farther down on the boiling curve. Eventually, equilibrium may be reestablished only at point b in the film-boiling region. This temperature usually exceeds the melting temperature of the wire, so that burnout results. If the electric-energy input is quickly reduced when the system attains point a, it may be possible to observe the partial nucleate boiling and unstable film region.

In nucleate boiling, bubbles are created by the expansion of entrapped gas or vapor at small cavities in the surface. The bubbles grow to a certain size, depending on the surface tension at the liquid-vapor interface and the temperature and pressure. Depending on the temperature excess, the bubbles may collapse on the surface, may expand and detach from the surface to be dissipated in the body of the liquid, or at sufficiently high temperatures may rise to the surface of the liquid before being dissipated. When local boiling conditions are observed, the primary mechanism of heat transfer is thought to be the intense agitation at the heat-transfer surface which creates the high heat-transfer rates observed in boiling. In saturated, or bulk, boiling the bubbles may break away from the surface because of the buoyancy action and move into the body of the liquid. In this case the heat-transfer rate is influenced by both the agitation caused by the bubbles and the vapor transport of energy into the body of the liquid.

Experiments have shown that the bubbles are not always in thermodynamic equilibrium with the surrounding liquid; i.e., the vapor inside the bubble is not necessarily at the same temperature as the liquid. Considering a spherical bubble as shown in Fig. 9-3, the pressure forces of the liquid and vapor must be balanced by the surface-tension force at the vapor-liquid interface. The pressure force acts on an area of πr^2, and the surface tension acts on the interface length of $2\pi r$. Making the force balance,

$$\pi r^2(p_v - p_l) = 2\pi r\sigma$$

or

$$p_v - p_l = \frac{2\sigma}{r} \tag{9-17}$$

NRC SRO Exam 9/2 Comments

Section 5.0

5.15 See RO Comment 1.15

5.17 See RO Comment 1.17

5.20 See RO Comment 1.20

Section 6.0

6.02 See RO Comment 2.15

6.04 NI-41 will only affect level control for A and D S/G's. Only one channel of Lo-Lo level trip will be affected for each S/G. See Reference 6.04.

6.06 Should accept 120°F ± 10%

6.17 Should accept 82%

Section 7.0

7.02 Should also accept take another sample and calculate new setpoint.

7.05 Should also accept >100 mrem in 5 consecutive days or > 2mr/hr. See Reference 7.05.

7.06 Answer should be 35 MPC-Hrs/Wk. See Reference 7.06.

7.07 Should accept 90% or 1000mrem. See Reference 7.07.

7.15 Answer given is the same thing as saying FEED and BLEED.

7.16 Should also accept 105 gpm of 2000ppmB. See Reference 4.08

7.18 Should also accept CAPT On-Off switch on SSF panel. See Reference 7.18.

7.28 Should accept from S/B Makeup Pump.

Section 8.0

8.01 Answer should be to stay within 10CFR100 limits. See Reference 8.01.

8.07 Point valve is to high relative to other administrative question.

8.09 Accept other names such as:

Tag Discrepancy Form or
Tag Violation Form

Should not be expected to know the exact name of this form.

8.11b Should also accept "or designee". See Reference 8.11.

8.12 Should also accept Assistant Shift Supervisor or other Supervisor with Operational Control. See Reference 8.12

8.14 Two Candidates were told that a procedure change could be used and answered it based on that.

1) The answer for this should be: Put in a temporary Procedure Change which requires two signatures (Unit or Shift Supervisor and Assistant Oper Eng., Oper Eng. or Duty Engineer)

2) Or the answer could be N/A the step with SRO initials.

3) Or accept answer on Key.

See Reference 8.14

8.17 Accept D or C as it could be called either way. Reference 8.17.