ENCLOSURE 1

EXAMINATION REPORT - 50-413/OL-85-01

Facility Licensee: Duke Power Company

Facility Name: Catawba

Facility Docket No. 50-413

Written and oral examinations were administered at Catawba near Clover, South Carolina.

Chief Examiner: A. H. Johnson — Date Signed: 2/21/85

Approved by: Bruce A. Wilson, Section Chief — Date Signed: 2/24/85

Summary:

Examinations on January 8 - 10, 1985

Oral examinations were administered to eight candidates, all of whom passed. Ten candidates were administered written examinations, six of whom passed.

REPORT DETAILS

1. Persons Examined

SRO Candidates:

G. B. Ice
S. M. Janeski
L. B. Long
P. J. Loss
A. C. Miller
H. M. Rybczyk
C. W. Senn

RO Candidates:

J. W. Brown
E. A. Crisp
J. D. Ferguson
R. L. White

Other Facility Employees Contacted:

*J. W. Hampton, Plant Manager
*S. R. Frye, Director of Operator Training
*W. H. Barron, Senior Instructor
C. Muse, Operating Engineer
T. Moore, Associate Engineer
D. Tower, Operating Engineer
C. Kiker, Associate Instructor
G. Spurlin, Associate Instructor
F. Henry, Associate Engineer

*Attended Exit Meeting

2. Examiners:

*A. H. Johnson
E. A. Cook
B. Sailor

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners met with G. Spurlin, C. Kiker, T. Moore, F. Henry, C. Muse, and D. Tower to review the written examination and answer key. The following verbatim comments were made by the facility reviewers:

a. SRO Exam

1. QUESTION 5.11

Facility Comment: By new curves, Xe concentration does change our rod worth. Graph provided.

NRC Resolution: Curve 6.3.1 of OP/1/A/6700/01 shows rod worth changing with Xe concentration. Question deleted since there is no correct answer.

2. QUESTION 6.04

Facility Comment: Spec 3.6.5.1 gives specs for ice condenser which make the d answer correct. Selection b is also correct per FSAR. Same on RO exam.

NRC Resolution: Typographical error on the exam. Either choice b or d accepted as the correct answer.

3. QUESTION 7.04

Facility Comment: EP-01 lists five actions in RNO column if reactor is not tripped. Request accept "go to ATWS procedure" as an answer.

NRC Resolution: Proposed answer would have been accepted; but it was not given by candidates.

4. QUESTION 7.15

Facility Comment: Question does not specify which Reactor Coolant Pump breaker is being racked out. Our Reactor coolant pumps have two breakers, one breaker requires pulling fuses and the other breaker doesn't.

NRC Resolution: Question was obtained from system description, Q-CM-NCP which made no mention of two different breakers. OP/0/A/6350/10 verifies accuracy of facility comment. Question deleted.

5. QUESTION 8.13

Facility Comment: Our reports in Tech Spec have been changed. We no longer require a report if an action statement is entered. Section 6.9 now only lists routine reports.

NRC Resolution: Question was based on "Proof and Review" copy of Tech Specs provided to examiners as reference material. New Tech Spec issued with 5% OL did not have this reporting requirement.

6. QUESTION 8.15

Facility Comment: Correct answer should be a. We do not report to the Superintendent on a site assembly. S.D. 3.0.7, 2.4.

NRC Resolution Station Directive 3.0.7 paragraph 2.4 provides clearer guidance than Site Emergency Plan. Answer changed from (b) to (a).

7. QUESTION 8.16

Facility Comment: X/Q - not used in our calculations. This factor is figured in prior to operators using RP-11. We do not teach X/Q as a dispersion factor.

NRC Resolution: Procedure RP/0/A/5000/11 verifies accuracy of statement. Question deleted.

b. RO Exam

1. QUESTION 1.14

Facility Comment: As taught and normally thought of, power production is in the power range. Shortly after a reactor trip neutron level is out of the power range, which would make this question false in light of the first statement. We recommend this question be thrown out.

NRC Resolution: Question deleted. Various references such as NUS- "Reactor Operation", pg. 14.3-1 support the statement that production of power by fission after a reactor trip is contradictory.

2. QUESTION 2.09

Facility Comment: The expected answer is correct as per Catawba FSAR. Selection (d) is also correct as per Catawba Tech Specs (See Attached Reference 2.09). Therefore b or d should be accepted as correct.

NRC Resolution: See resolution of SRO Question 6.04.

3. QUESTION 3.10

Facility Comment: This question from the Catawba Exam Bank has been previously discovered by Catawba Training Department to have two correct answers. It has since been changed to solicit just one correct answer (See attached reference 3.10). As appearing on the exam a or c should be accepted as correct.

NRC Resolution: References provided support both answers. A or C accepted as correct answer.

4. QUESTION 4.05

Facility Comment: For any procedure to be used, the initial conditions are required to be satisfied. The expected response comes from the procedure purpose. Here both the purpose and the initial conditions are required to be met. Therefore, any combination of three from the purpose or initial conditions should be accepted as correct.

NRC Resolution: The three answers obtained from Section 1.0 of OP/1/A/6100/05 are also contained in Enclosure 4.1 of the same OP. Therefore, any combination of three conditions from either source will be accepted.

5. QUESTION 4.04

Facility Comment: There are five actions given in the 'response not obtained' column. Therefore four of the five should be accepted in any combination as correct.

NRC Resolution: See resolution of SRO Question 7.04.

6. QUESTION 4.15

Facility Comment: The reactor coolant pump motor has two supply breakers in series (6900V switchgear breaker and the safety breaker). The procedure for racking out the 6900V switchgear breaker has no fuses pulled, which would leave no correct answer if the examinee chose this breaker. If the examinee chose the other breaker, then he would pull two fuses. With no correct response for one of the two breakers, we recommend the question be thrown out.

NRC Resolution: See resolution of SRO Question 7.15.

4. Exit Meeting

At the conclusion of the site visit, the examiners met with representatives of the plant staff to discuss the results of the examination. Those individuals who clearly passed the oral examination were identified.

There were no generic weakness noted during the oral examination.

NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

Enclosure 3 (1 of 2)

(1)

MASTER

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

Facility: Catawba
Reactor Type: PWR-W
Date Administered:
Examiner: A. Johnson and E. Cook
Candidate:

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
~~26~~ 24	~~25~~ 24			5. Theory of Nuclear Power Plant Operation, Fluids, and Thermodynamics
25	25			6. Plant Systems Design, Control, and Instrumentation
~~26~~ 24	~~25~~ 22			7. Procedures - Normal, Abnormal, Emergency, and Radiological Control
~~25~~ 22	~~25~~ 22			8. Administrative Procedures, Conditions, and Limitations
~~100~~ 92	Final Grade			

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

Candidate's Signature

THEORY OF NUCLEAR POWER PLANT OPERATIONS, FLUIDS, AND THEROMODYNAMICS
TOTAL POINTS = 25

5.01 Indicate how the following will affect unit efficiency at steady state power level. (Consider the affected parameter only and indicate Increase, Decrease or No Change)

(a) Absolute condenser pressure changes from 30" Hg to 25" Hg (0.5)

(b) Total S/G blowdown is changed from 35 gpm to 40 gpm (0.5)

5.02 How does each of the following parameters change (INCREASE, DECREASE, or NO CHANGE) of one main steam isolation valve closes with the plant at 50% load. Assume all controls are in automatic and that no reactor trip occurs.

(a) Affected loop steam generator level (INITIAL CHANGE ONLY) (0.5)
(b) Affected loop steam generator pressure (0.5)
(c) Affected loop cold leg temperature (0.5)
(d) Unaffected loop steam generator level (INITIAL CHANGE ONLY) (0.5)
(e) Unaffected loop steam generator pressure (0.5)
(f) Unaffected loop cold leg temperature (0.5)

5.03 As the core approaches EOL, the building in of Pu-239 is not sufficient to compensate for the depletion of U-235. (Select one) (1.0)

a. True, but the higher yield of neutrons from fission of Pu-239 causes f to remain essentially constant.

b. True, but the major effect of core age is the building in of fission product poisons.

c. True, and as a result f decreases.

d. False, the major effect of core age is the building in of fission product poisons.

CATEGORY 5 CONTINUED ON NEXT PAGE

5.04 The NC system must always be maintained subcooled because: (1.0)
(Select one)

a. After the coolant becomes saturated the heat transfer rate out of the core stops.

b. Our instruments for measuring temperature will only measure subcooled liquids.

c. After the coolant becomes saturated you could get an increase in heat transfer without an increase in temperature indication.

d. Once the coolant becomes saturated the temperature indicators will measure the temperature of the steam exiting the core which will indicate how much superheat exists in the core.

5.05 The station has a precaution stating that the moderator temperature coefficient should not be positive during operation in Modes 1 & 2. What two parameters controlled by the operator can make the coefficient more negative? (0.5)

5.06 The follow statements concern subcritical multiplication. Choose the <u>one</u> [bracketed] word that makes the statements correct.

a. As Keff approaches unity, a [larger/smaller] change in neutron level results from a given change in Keff. (0.5)

b. As Keff approaches unity, a [shorter/longer] period of time is required to reach the equilibrium neutron level for a given change in Keff. (0.5)

5.07 On attached Figure 5.07 is a representation of how the resonance peaks of U-238 "flatten out" or Doppler broaden as fuel temperature increases. Which of the following are the correct labels for the X and Y axes? (1.0)

a. X is neutron flux, Y is interaction rate

b. X in neutron energy, Y is microscopic capture cross section.

c. X is atom density of U-238, Y is neutron flux.

d. X is microscopic capture cross section, Y is neutron density.

CATEGORY 5 CONTINUED ON NEXT PAGE

5.08 Which components of the six-factor formulas are most affected by a moderator temperature change? (1.0)

a. Thermal Utilization and Fast Fission
b. Resonance Escape and Reproduction
c. Reproduction and Fast Fission
d. Resonance Escape and Thermal Utilization

5.09 Which one of the following cause the FTC (pcm per degree F) to become less negative? (1.0)

a. Fuel temperature increases.
b. Moderator temperature increases.
c. Control rods are inserted.
d. Core age increases.

5.10 Concerning the behavior of Samarium-149, which one of the following statements is true? (1.0)

a. Once equilibrium Samarium is established, Samarium reactivity does not change regardless of power transients.

b. 50% equilibrium Samarium reactivity is equal to 100% equilibrium Samarium reactivity.

c. Samarium is only removed by radioactive decay.

d. Samarium is produced by the decay of Iodine.

5.11 Which one of the following will NOT cause an increase in rod worth? (Consider each separately) (DELETED) (1.0)

a. Reduction in boron concentration.
b. Increase in moderator temperature.
c. Depletion of burnable poisons.
d. Buildup of xenon concentration.

CATEGORY 5 CONTINUED ON NEXT PAGE

5.12 A motor driven centrifugal pump is operating at rated flow. You then start closing down on the discharge valve. How will each of the following be affected (increase, decrease, remain the same)?

a. Flow (.25)
b. Discharge pressure (.25)
c. NPSH-available (.25)
d. Motor amps (.25)

5.13 During a reactor startup the intermediate range instruments were indicating 2×10^{-11} amps when the Source Range Instruments were indicating 5×10^{3} CPS. What should the intermediate range indication be when the source range indicates 5×10^{4} CPS? (Select one) (1.0)

a. 7×10^{-11} AMPS

b. 2×10^{-10} AMPS

c. 10^{-10} AMPS

d. 5×10^{-10} AMPS

5.14 The reactor is operating at 50% power with the rod control system in manual when a single Group A rod drops into the core. Assuming no reactor trip or operator actions occur, choose the answer that best describes the final steady state conditions. (1.0)

a. Final power = initial power; final Tave less than initial Tave.
b. Final power = initial power; final Tave greater than initial Tave.
c. Final power less than initial power; final Tave less than initial Tave.
d. Final power less than initial power, final Tave greater than initial Tave.

5.15 Which one of the following parameter changes will result in an increased DNBR? (1.0)

a. Reactor power increases.
b. RCS pressure increases.
c. RCS temperature increases.
d. RCS flow decreases.

CATEGORY 5 CONTINUED ON NEXT PAGE

5.16 If steam goes through a throtting process, as in a main steam line leak, indicate whether the following parameters will INCREASE, DECREASE, or REMAIN THE SAME.

a. Enthalpy (0.5)
b. Pressure (0.5)
c. Entropy (0.5)

5.17 TRUE OR FALSE

a. The use of a ramped Tave program allows Catawba to operate with a higher thermodynamic efficiency than does a constant Tave program. (0.5)

b. Increasing condensate depression (subcooling) will cause BOTH a decrease in plant efficiency AND an increase in condensate (hotwell) pump NPSH. (0.5)

5.18 For the following, state whether the tensile stresses are maximum on the OUTER or INNER wall of the reactor pressure vessel.

a. Pressure Stress (0.5)
b. Heatup Stress (due to delta T only) (0.5)
c. Cooldown Stress (due to delta T only) (0.5)
d. Composite (Total) Stress during Cooldown (0.5)

5.19 Which one of the following is a symptom of deteriorating natural circulation flow in one of four operating loops? (1.0)

a. Increasing Delta-T across affected steam generator.
b. Decreasing Delta-T across affected steam generator.
c. Rapidly decreasing steam header pressure.
d. Rapidly increasing Th.

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

a. Flow in operating reactor coolant loops (0.5)
b. Core delta T (0.5)
c. Reactor vessel delta P (0.5)
d. Operating loop steam generator pressure (0.5)

CATEGORY 5 CONTINUED ON NEXT PAGE

5.21 If the turbine exhaust pressure increases due to a change in circulating water temperature, which one of the following is true: (1.0)

a. Exhaust quality increases and exhaust enthalpy decreases
b. Exhaust quality decreases and exhaust enthalpy decreases
c. Exhaust quality decreases and exhaust enthalpy increases
d. Exhaust quality increases and exhaust enthalpy increases

END OF CATEGORY 5

WRITE "END OF CATEGORY 5" ON YOUR ANSWER SHEET

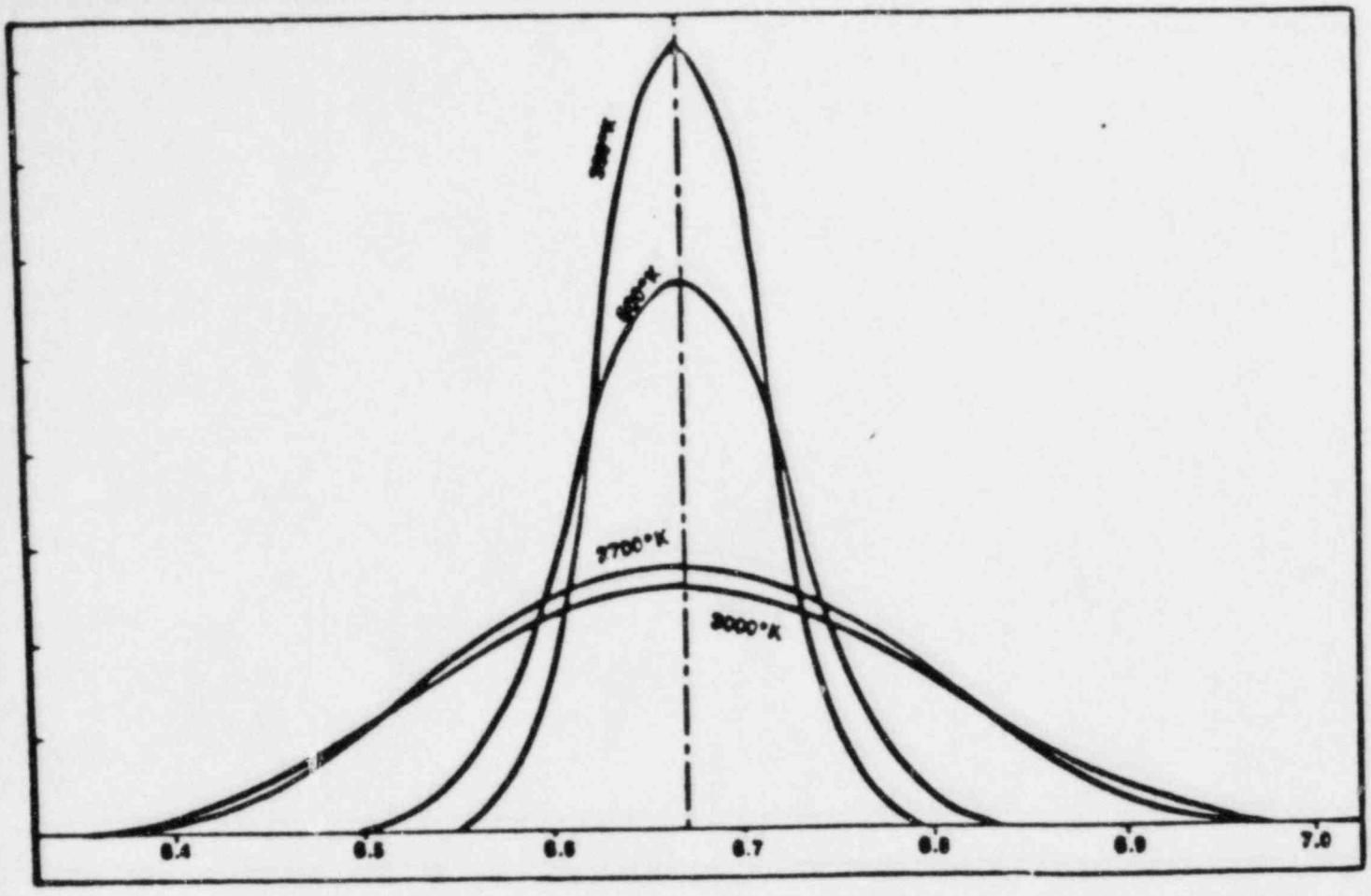

FIGURE 5.07

6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION

TOTAL POINTS = 25

6.01 The Main Steam safety valves are used for: (Select one) (1.0)

a. Overpressure protection during the most severe postulated loss of heat sink accident.

b. Overpressure protection following the most severe postulated steam line break accident.

c. Overpressure protection following a design basis accident.

d. Overpressure protection following a S/G overfill accident.

6.02 What is the purpose of the flow restrictor in the outlet of each S/G? (Select one) (1.0)

a. Provide flow to the SSPS for SM isolation on high steam flow.

b. Limits flow out of the S/G in the event of a S/G tube rupture to prevent overfill condition.

c. Limits flow out of the S/G in the event of a steam line rupture to reduce S/G thrust loading.

d. Provides flow to the SGWLC System to maintain programmed S/G pressure.

6.03 The cation bed demineralizers are placed in service to control __1__ and __2__. (1.0)

a. (1) Lithium, (2) Oxygen

b. (1) Lithium, (2) Cesium

c. (1) Cesium, (2) Hydrazine

d. (1) Hydrazine, (2) Oxygen

CATEGORY 6 CONTINUED ON NEXT PAGE

6.04 Which one of the following is true about the Catawba ice condensers? (Select One) (1.0)

a. The Sodium Tetraborate Solution will absorb Neutrons and retain Iodine and Noble gases.

b. The Ice Bed will reduce containment peak temperature and pressure after a LOCA.

c. The Ice Bed will be at least 2200 ppm Boron as Sodium Tetraborate and a pH of 8.5 to 9.5.

d. The Ice will be contained in a minimum of 1,944 baskets and the total ice weight shall be at least 2,368,652 pounds at confidence 95%.

6.05 The purpose of the flow orifice in the Cold Leg Accumulator (CLA) discharge line is: (Select one) (1.0)

a. To equalize the flow to the Cold Leg Accumulators

b. To extend the blowdown time of the Cold Leg Accumulators during a loss of coolant accident.

c. To provide a method to measure the flow from the CLA's during a loss of coolant accident.

d. To provide a method to measure flow when testing both CLA discharge check valves for leakage.

6.06 Which one of the following is a function of the EHC system? (1.0)

a. Maintain constant load for steam dump failures <10% F. P.

b. Maintain grid frequency +0.3HZ for all normal reactor power level changes.

c. Allows reactor trip from 100% load without lifting the ASME Code main steam safety valves.

d. Prewarming of the steam chest and turbine rotor.

CATEGORY 6 CONTINUED ON NEXT PAGE

6.07 Which one of the following statements is true regarding the Vital I & C standby battery charger: (Select One) (1.0)

a. Only one output breaker can be shut at one time.

b. Input sources must be synchronized prior to closing a second input breaker.

c. It is normally fed from two MCCs in parallel.

d. They perform as inverters upon loss of AC power.

6.08 Which on of the following reactor control system auto-rod control setpoints is in agreement with those stated in the Catawba Plant Summary Manual? (1.0)

a. dead band 2.0 degree F

b. lock up 0.5 degree F

c. min. speed 30"/min.

d. max. speed 64 steps/min.

6.09 Which one of the following control systems would <u>not</u> be directly affected by a T-hot RTD failed high? (1.0)

a. Steam dump control

b. Steam generator level control

c. Rod Control

d. Pressurizer level control

6.10 While operating at 100% power, power range channel NI-41 fails low. The response of the S/G level control system will be: (Choose one) (1.0)

a. If the channel is controlling S/G A and D, B and C level will increase to 66%.

b. If the channel is controlling S/G B and C, A and D level will decrease to 38% level which will result in a S/G Lo-Lo level reactor trip.

c. No effect upon the system.

d. Channel I trip setpoint for all four S/G's will be reduced to ~~12%~~ 17%.

CATEGORY 6 CONTINUED ON NEXT PAGE

6.11 Which one of the following statements regarding Reactor Trip System Interlocks is true? (1.0)

a. On decreasing power, P-6 allows the manual restoration of the source range level trips and source range high voltage.

b. 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 low pressure, and pressurizer high level.

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

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

6.12 The pressurizer level control system is primarily designed to: (1.0)
(Select One)

a. Provide protection for the reactor coolant system against low pressure DNB

b. Limit changes in reactor coolant system pressure during all modes of unit operation.

c. Provide satisfactory operation without a reactor trip during load increases or decreases at 10% of full power per minute.

d. Maintain water level in the pressurizer within an acceptable program range under all load conditions during operation.

6.13 Indicate which of the following statements is true concerning the construction and operation of the Power Range N.I. detector. (1.0)
(No explanation is required.)

a. Has Boron-Trifluoride (BF_3) gas in the outer volume of the detector but not in the inner volume.

b. Has Boron-Trifluride (BF_3) gas in both inner and outer volumes of the detector.

c. Operates in the proportional region of the gas amplification curve (detector current vs. voltage curve).

d. Uses no compensation circuitry to remove gamma current.

CATEGORY 6 CONTINUED ON NEXT PAGE

6.14 Which one of the following protective features associated with excore NI's can be completely blocked or bypassed? (1.0)

a. PR high flux high setpoint trip

b. PR positive rate trip

c. PR high flux low setpoint trip

d. Overpower delta T trip

6.15 A small leak in the pressurizer reference leg drops the level in the reference leg by 10 inches. Indicated pressurizer level will: (Select one) (1.0)

a. Drop by 10 inches.

b. Drop by 20 inches.

c. Increase by 10 inches.

d. Not change.

6.16 The S/G PROV Setpoints are: (1.0)

a. Open 1125 psig, close 1065 psig

b. Open 1165 psig, close 1025 psig

c. Open 1065 psig, close 1025 psig

d. Open 1125 psig, close 1025 psig

6.17 If power is connected to the Cold Leg Accumulator (CLA) outlet isolation valves they will (select one) (1.0)

a. Automatically close when control is swapped to the Auxiliary Shutdown panel.

b. Automatically close on a Lo-Lo level in the respective CLA with an S_S signal present.

c. Automatically close when the reactor coolant system decreases below P-11 (1955 psig).

d. Automatically close on a low steam line pressure safety injection signal since the CLA's are not required for a steam break accident.

CATEGORY 6 CONTINUED ON NEXT PAGE

6.18 Following an ESFA signal, which one of the following statements is true concerning the RN system? (Select one) (1.0)

a. The non-essential header is isolated.

b. The channel cross-overs close.

c. All RN pumps start.

d. The diesel generators supply the RN pumps.

6.19 Choose the correct response of the NV system to an S_S signal. (1.0)

a. All charging pumps start

b. Excess letdown isolates

c. Auxiliary pressurizer spray isolates

d. Boric acid pumps start

6.20 Which one of the following is true of the S/G PORV's? (1.0)

a. Can be operated from either ASP 'A' or ASP 'B'.

b. Can be locally operated by air loader.

c. Use for cooldown during normal shutdown.

d. Used to limit safety valve actuation.

6.21 Which of the following is true concerning hydrogen in the VCT? (1.0)

a. It is supplied from the waste gas shutdown tanks.

b. It is maintained at 50 psig to supply proper backpressure on #2 NC pump seal.

c. It must be kept less than 30 cc/kg per tech specs.

d. It is necesary for oxygen scavenging.

CATEGORY 6 CONTINUED ON NEXT PAGE

6.22 The containment spray water is returned to the containment sump from the containment upper level during containment spray operation through the: (Select one) (1.0)

a. Ice Condenser lower doors
b. Divider barrier
c. Ice Condenser floor drains
d. Refueling cavity drains

6.23 Which one of the following statements is true concerning the KF system? (1.0)

a. The skimmer trough is adjustable to ensure adequate suction pressure for the skimmer pump.

b. Maximum KF demineralizer prefilter D/P is 35 psid.

c. Purification loop flow shall not exceed 530 GPM.

d. Purification loop flow is adjusted by throttling the KF pump discharge valves.

6.24 Which one of the following statements concerning feedwater heater shells is true: (Select One) (1.0)

a. First stage reheater drain tank drains to "A" CF heater.

b. Second stage reheater drain tank drains to "B" CF heater.

c. Moisture Separater Reheater drain tank drains to "C" CF heater drain tank.

d. "B" CF heater drains will drain to "B" CF heater.

6.25 Which one of the following is NOT a waste gas compressor trip? (1.0)

a. High moisture separator pressure.
b. Low moisture separator pressure.
c. High suction pressure.
d. Low suction pressure.

END OF CATEGORY 6

WRITE "END OF CATEGORY 6" ON YOUR ANSWER SHEET

7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL
TOTAL POINTS = 25

7.01 During a plant cooldown the operator must: (select one) (1.0)

a) Lock out the NI pumps when cold leg temperature is below 400°F.

b) Be prepared to manually initiate safety injection if the plant is above P-11.

c) Borate NC to value found using Unit Shutdown Procedure prior to blocking NI.

d) Block NI when NC pressure drops below 1,950 psig.

7.02 During a plant start up while forming a steam bubble in the pressurizer, the level is maintained at ____ per cent. (select one) (0.5)

a) 100
b) 95
c) 62
d) 25

7.03 During a plant start up while forming a steam buble in the pressurizer the nitrogen blanket in the pressurizer has to be vented. Nitrogen venting of the pressurizer is considered to be complete when: (select one) (1.0)

a) PRT pressure increase with a corresponding decrease in pressurizer level.

b) PRT pressure increases with a corresponding decrease in the PRT level.

c) PRT pressure does not increase with a corresponding increase in pressurizer level.

d) PRT pressure does not increase with a corresponding increase in PRT level.

7.04 List the four (4) actions required in EP-01 reactor trip or SI if the reactor fails to trip. (1.0)

7.05 State the three <u>required</u> plant conditions which <u>must</u> be met for returning the reactor unit to power, following a reactor trip, by the "Unit Fast Recovery" procedure OP/1/A/6100/05. (1.0)

CATEGORY 7 CONTINUED ON NEXT PAGE

7.06 List the five (5) immediate actions, assuming all expected responses are obtained, for EP-01, "Reactor Trip or Safety Injection." (1.5)

7.07 Above _____% power of CF is lost to the S/G's, the operator is instructed to manually trip the reactor. (0.5)

7.08 What action is required during a reactor start up if criticality is attained below the control rod Tech. Spec. insertion limit? (select one) (1.0)

a) Emergency borate and continue withdrawing control banks to maintain criticality, until the control banks are above their Tech. Spec. insertion limit.

b) Immediately borate and continue withdrawing control banks to maintain criticality, until the control banks are above their Tech. Spec. insertion limit.

c) Insert all control banks and notify the Reactor Group Unit Engineer or Performance section Duty Engineer.

d) Stop withdrawing rods and recheck ECP calculations are not in error, contact the Reactor Group Unit Engineer or the Performance Duty Engineer.

7.09 During a steam generator tube rupture, concurrent with a loss of off-site power, the most desirable heat sink is: (Select One) (1.0)

a) Main condenser.

b) Letdown heat exchanger.

c) Steam generator PORVs.

d) Pressurizer PORVs.

CATEGORY 7 CONTINUED ON NEXT PAGE

7.10 Indicate if each of the statements below are True or False. (2.5)

a) All shutdown banks must be fully withdrawn before the reactor is brought critical.

b) Flux multiplication rates should not be permitted to exceed 2 decades/minute administrative limit.

c) If steam dump is actuated, steam dump control should not be reset manually until equilibrium conditions are established.

d) The automatic safety injection signal from low pressure will be automatically unblocked when RCS pressure is below 1955 psig.

e) Premissive circuit P-6 setpoint is 1×10^{-10} amps.

7.11 The proper method to startup and parallel a Diesel Generator is: (1.0)
(select one)

a) Voltages are equal, breaker is closed at 12 o'clock with the sync needle rotating rapidly in the fast direction.

b) Diesel Generator voltage lower than grid voltage, breaker is closed at 12 o'clock with the sync needle rotating slowing in the slow direction.

c) Voltages are equal, breaker is closed at 12 o'clock with the sync needle rotating slowly in the slow direction.

d) Voltages are equal, breaker is closed at 12 o'clock with the sync needle rotating slowly in the fast direction.

7.12 Steam generator level is maintained at the proper value by: (1.0)
(select one)

a) Modulating the main feedwater regulating valves above 15% power.

b) The feed regulating bypass valves up to 15% power, and when they are fully open, the main feedwater regulating valves take over.

c) The feed water regulating bypass valves up to 29% power.

d) Varying feedwater pump speed based on the rate of decrease of level in the steam generator.

CATEGORY 7 CONTINUED ON NEXT PAGE

7.13 All unit and security computers are to be secured if computer room temperature exceeds _____°F. (Select one) (0.5)

a) 95°F
b) 80°F
c) 78°F
d) 85°F

7.14 Which one of the following correctly states a limit/precaution of the Catawba Turbine Control (EHC) system? (1.0)

a) Operation below 5% load should be kept to a minimum to prevent motoring of the unit.

b) Bearing oil temperature rise across the main bearings should not exceed 110 degree F.

c) The turbine should not be operated with condenser vacuum less than 21.8 inches Hg.

d) Do not allow Turbine Generator speed to exceed 2010 rpm on overspeed tests.

7.15 Prior to racking out a Reactor Coolant Pump Breaker, the operator wishes to remove control power to the breaker. To do this, the operator must: (Select One) (1.0)

(DELETED)

a) Remove the control power fuses from the control room back panel.

b) Remove one set of fuses from inside the breaker cabinet.

c) Remove two sets of fuses from inside the breaker cabinet.

d) Place the pump control switch in pull to lock.

7.16 The temperature of both the reactor and secondary coolants in the steam generators shall be greater than _____ when the pressure of either coolant in the steam generator is greater than 200 psig (select one) (0.5)

a) (1) 212°F

b) (1) 350°F

c) (1) 160°F

d) (1) 70°F

CATEGORY 7 CONTINUED ON NEXT PAGE

7.17 When the steam generators are in wet layup, steam generator level is maintained: (select one) (1.0)

a) Up to the outlet nozzles to minimize corrosion.

b) 14 feet below the nozzles to minimize steam generator support stress.

c) At the program level for 0% power.

d) Four feet below the outlet nozzles the protect the steam line pipe hangers.

7.18 With a decreasing condenser vacuum, the turbine MUST be tripped if: (select one) (1.0)

a) Exhaust hood temperature is 230°F.

b) Condenser Vacuum is 23"HG.

c) Condenser circulation water outlet temperature is 103°F.

d) ZP system is out of service.

7.19 When a fire is indicated on the fuel pool ventilation system filter bed, the operator should: (select one) (1.0)

a) Ensure auto trip occurs on exhaust fan, dispatch operator to open deluge valve.

b) Trip the exhaust fan, dispatch an operator to open the deluge valve.

c) Ensure exhaust fan auto trips, open the deluge valve from the fire protection panel.

d) Trip the exhaust fan, ensure deluge valve auto opens.

7.20 Following VE system auto start, what action must the operator take to secure the system? (select one) (1.0)

a) Reset the sequencer, verify the fans automatically stop

b) Reset the sequencer, depress stop pushbuttons for fans

c) Depress stop pushbuttons for the fans

d) Verify the fans stop after the initiating signal has cleared.

CATEGORY 7 CONTINUED ON NEXT PAGE

7.21 While at low power level, steam withdrawal from the S/G must be slow. What is the reason for this precaution? (1.0)

a) Prevent receiving a high steam line flow MSIV closure.

b) Prevent the core from going critical.

c) Prevent reactor power from increasing.

d) Prevent reducing Tave below 551°F.

7.22 During the preformance of the MSIV movement PT, the MSIV's should move to what position? (1.0)

a) 90% closed

b) 90% open

c) 10% open

d) 50% closed

7.23 During removal of safety tags for testing, tags shall not be be lifted under any circumstances for more than (Select one) (1.0)

a) 72 hours

b) 24 hours

c) 12 hours

d) 8 hours

7.24 Which one of the following should be done if letdown isolates and cannot be regained. (1.0)

a) Cycle the reactor vessel head vents as needed to maintain pressurizer level at disired value.

b) Secure pressurizer heaters to prevent high pressurizer pressure due to higher pressurizer level.

c) Secure all charging pumps to prevent overfill of the pressurizer.

d) Reduce charging flow to supply NC Pump seals, secure normal charging, and establish excess letdown.

CATEGORY 7 CONTINUED ON NEXT PAGE

7.25 What is your maximum quarterly whole body exposure limit which you could receive without an approved extension? (Select one) (DUKE POWER) (1.0)

a. 1250 Millirem
b. 1000 Millirem
c. 3000 Millirem
d. 500 Millirem

END OF CATEGORY 7

WRITE "END OF CATEGORY 7" ON YOUR ANSWER SHEET

8. Administrative Procedures, Conditions, and Limitations TOTAL POINTS=25

8.01 TRUE OR FALSE

For Reactor Trip System instrumentation, according to Tech Specs, 3/4 level channels per S/G must be operable in modes 1, 2, and 3. (0.5)

8.02 TRUE OR FALSE

S/G level indication is required in the control room per specification 3.3.1 (Reactor Trip System Instrumentation), at the auxiliary shutdown panel per specification 3.3.3.5 (Remote Shutdown System) and is required per specification 3.3.2 (Engineered Safety Features Actuation System Instrumentation) (0.5)

8.03 TRUE OR FALSE

The cold leg accumulators operate during the reflood stage of an intermediate or large Reactor Coolant system break to provide additional water for cooling to limit peak fuel centerline temperature to less than 2200°F. ~~(select one)~~ (0.5)

8.04 TRUE OR FALSE

If NC pressure is less than or equal to 1600 psig, INI-118A (NI pump 1A C-Leg Inj. Iso.) must be closed while filling a Cold Leg Accumulator. This condition will violate Tech Specs if NC temperature is greater than or equal to 350°F. ~~(select one)~~ (0.5)

8.05 Which area radiation monitor must be operable, per Tech. Specs, in the Spent Fuel pool area? (1.0)

a) EMF-17, Radiation level Reactor Bldg. Bridge

b) EMF-42, High gaseous radiativity

c) EMF-17, Radiation level spent fuel bldg.

d) EMF-15, Criticality - Radiation level fuel bridge

SECTION 8 CONTINUED ON NEXT PAGE

8.06 The basis for the annulus ventilation system Tech Specs is to: (select one) (1.0)

a) Ensure releases from containment do not exceed 10 CFR 20 limits for personnel exposure.

b) Ensure the annulus will not be overpressurized due to leakage from containment following an accident.

c) Ensures that leakage from containment will be filtered thru a HEPA filter prior to release.

d) Provide a method of evacuating the containment building following an accident.

8.07 There are three basic methods for limiting the release of fission products from containment. One of these is: (Select One) (1.0)

a) Provide complete isolation of containment following any accident.

b) Ensure containment pressure and temperature do not exceed a maximum value.

c) Periodically verify operability of all containment evacuation systems.

d) Minimize the amount of fuel loaded into the core.

8.08 The VC-YC system chlorine detectors are required by Tech Spec to be operable in which modes? (select one) (1.0)

a) 1, 2, 3

b) 1, 2, 3, 4

c) 1, 2

d) All modes

8.09 According to Tech Spec. 3.7.1.4, the MSIV's are required to be operable in what modes? (1.0)

a) 1, 2, 3, 4

b) 1, 2, 3

c) 1, 2

d) All modes

SECTION 8 CONTINUED ON NEXT PAGE

8.10 During an inadequate core cooling emergency, TSC concurrence must be obtained prior to initiating Containment Hydrogen Purge due to: (select one) (1.0)

a) Danger of explosion.
b) Potential path of Radioactive Release.
c) Danger over-pressurization of containment.
d) TSC has instrumentation not available to operator.

8.11 Which one of the following is <u>not</u> a part of the Westinghouse criteria for condition II event? (Faults of Moderate Frequecny) (1.0)

a) No clad damage
b) No fuel melting
c) DNBR < 1.3
d) Fuel centerline temperature < 4700 degree F

8.12 Which one of the following is <u>not</u> a condition III event? (infrequent fault) (1.0)

a) Complete loss of force reactor coolant flow
b) Waste gas decay tank rupture
c) Small LOCA
d) Fuel Handling accident

8.13 Match the following conditions with the correct reporting requirement. (2.0)

____ 1. Limiting safety system setting exceeded.

____ 2. Conditions leading to operation in a degraded mode permitted by limiting condition for operation.

____ 3. Failure of pressurizer PORV's.

____ 4. Reactor protection system instrument settling found to be less conservative than those established by Technical Specifications but which does not prevent the fulfillment of the functional requirements of affected systems.

A. Prompt Notification
B. Thirty Day Written Report
C. No Report Required

SECTION 8 CONTINUED ON NEXT PAGE

8.14 A pressurizer level channel is discovered to be reading 6% different than the other channels. What actions will the SRO take? (select one) (1.0)

a) Shutdown to hot standby within six hours.

b) Notify the NRC by the red phone within one hour and shutdown to hot standby within the next six hours.

c) Declare that channel inoperable, notify the NRC by red phone within one hour, and place that channel's bistables in the tripped position.

d) Declare that channel inoperable, log in Tech Spec Action Item Logbook, and place that channel's bistables in the tripped position within one hour.

8.15 In the event of a nuclear incident each person on site is accounted for by: (select one) (1.0)

a) Each person reporting to his/her assembly point and the supervisor at the assembly point will report the accountability of personnel to security within thirty minutes.

b) Each person notifying his/her supervisor, who in turn reports anyone that is unaccounted for to the appropriate Superintendent within thirty mintes.

c) Essential personnel reporting to the Technical Support Center within 10 minutes and non-essential personnel reporting to the "Alpha" offsite emergency support station within thirty minutes.

d) Each non-essential person reporting to the upper parking lot within thirty minutes and each essential person reporting to the containment airlock in double anti "C"s within 15 minutes to repair equipment.

8.16 Three factors that can affect X/Q are: (select one) (DELETED) (1.0)

a) Shape of release source, wind speed, concentration of plume
b) Shape of release source, wind direction, receiving area.
c) Shape of release source, wind speed, receiving area.
d) Shape of receiving area, wind direction, wind speed.

SECTION 8 CONTINUED ON NEXT PAGE

8.17 Meteorlogical data necessary for release rate calculations include: (select one) (1.0)

a) Wind speed, Wind direction, relative humidity
b) Wind speed, dew point, delta T
c) Delta T, relative humidity, dewpoint
d) Wind speed, Wind direction, delta T

8.18 The major contribution to radiation levels in the reactor building with the plant shutdown is _____. (select one) (1.0)

a) Nitrogen - 16

b) Argon - 14

c) Iron - 56

d) Cobalt - 60

8.19 During refueling operations the indication of a stuck fuel assembly during removal from the core are: (1.0)

a) Selsyn increasing, fuel gripper overload light

b) Dillon increasing, fuel gripper overload light

c) EMF-17 Radiation level stops increasing, fuel gripper slow zone amber light

d) Dillon decreasing, fuel hoist overheat warning light

8.20 Which one of the following is a correct statement of a description of an interlock bypass for the spent fuel pit side conveyor system controls? (select one) (1.0)

a) Valve Interlock Bypass - allows conveyor car to transfer without valve full open.

b) Bridge Interlock Bypass - allows conveyor car to transfer with the Spent Fuel Manipulator Crane in the area.

c) Lift Interlock Bypass -allows operator to stop the pump when frame is down and allows the conveyor car to transfer with the Spent Fuel Manipulator Crane in the area.

d) Traverse Interlock Bypass - allows conveyor car to traverse without valve full open.

SECTION 8 CONTINUED ON NEXT PAGE

8.21 Which one of the following is a correct statement of a description of an interlock bypass for the Reactor building manipulator crane? (select one) (1.0)

a) Fuel Gripper Interlock Bypass - bypasses interlocks associated with the fuel gripper by directing air directly to the gripper operating cylinder which also bypasses the mechanical lock.

b) Rod Hoist Interlock Bypass - allows operation of the Rod Hoist in the absence of the rod gripper disengaged, thimble plug engaged, or rod engaged. Also, bypasses inner most latch interlocks with rod hoist.

c) Rod Gripper Up First Stage Bypass - allows rod gripper to continue to the second stage position.

d) Trolley Interlock Bypass - allows fuel hoist to move up or down while the Trolley moves either left or right.

8.22 A person may enter a space containing a high pressure steam relief device during Mode 1 provided: (select one) (1.0)

a) He notifies the Shift Supervisor and wears a SCBA.

b) He notifies the Shift Supervisor and logs into the CR Logbook his time of entry and exit.

c) He notifies the Shift Supervisor and uses the Buddy System.

d) The steam line relief for that space is isolated.

8.23 Choose the correct statement concerning the Tech Specs associated with the NV System. (1.0)

a) In Modes 5 and 6, two boration flow paths are required to be operable.

b) In Modes 1, 2, and 3, two centrifugal charging pumps shall be operable.

c) Only one centrifugal charging pump can be operable in Mode 3 with NCS temperature less than 300°F.

d) Both centrifugal charging pumps must be operable at all times while in Mode 4.

SECTION 8 CONTINUED ON NEXT PAGE

8.24 Which one of the following is not a design criteria of the ECCS subsystems: (1.0)

a) Maintain clad temperature < 2200 degree F.

b) Ensure H_2 production of < 1% of volume obtained if all metal water reactions occur.

c) Keep clad oxidation < 17% of clad thickness at the most limiting point.

d) Provide for long term cooling capability.

8.25 While in Mode 1 with one Cold Leg Accumulator inoperable, except as a result of a closed isolation valve: (select one) (1.0)

a) Restore the inoperable accumulator to operable status immediately or be in at least hot standby within the next 6 hours.

b) Restore the inoperable accumulator to operable status immediately and be in at least hot standby within the next 6 hours.

c) Continue operating. (three accumulators operable meets the requirements of Tech Specs)

d) Restore the inoperable accumulator to operable status within one hour or be in at least hot standby within the next 6 hours.

8.26 The Tech Spec limits for nitrogen pressure for the Cold Leg Accumulators in Mode 1 are: (select one) (1.0)

a) 405 - 464 psig
b) 300 - 400 psig
c) 385 - 481 psig
d) 1000 - 1248 psig

END OF SECTION 8

WRITE "END OF SECTION 8" ON ANSWER SHEET

5. THERORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
(ANSWERS)

5.01 a. Decrease (0.5)
b. Decrease (0.5)

Reference: General Physics Company HTFF February 1981,
Section 1.6 Typical PWR Cycle
CAT - ROAB pg. 3 - ROAB pg. 9

5.02 a. Decrease (0.5)
b. Increase (0.5)
c. Increase (0.5)
d. Increase (0.5)
e. Decrease (0.5)
f. Decrease (0.5)

Reference: General Physics Company HTFF
Fluid Flow Applications
CAT - THERMA - FORM

5.03 c (1.0)

Reference: CAT - Q-RT-NMF-06

5.04 c (1.0)

Reference: CAT - THF-FF-03

5.05 1. Boron concentration (0.25)
2. Moderator temperature (Tavg) (0.25)

Reference: CATAWBA Exam Book, Vol. II, Pg. 54.

5.06

a. Larger (0.5)

Reference: Westinghouse Nuclear Sources and Subcritical
Multiplication - Relationship Between Subcrit-
ical Multiplication and Keff pg. I-4.13
CAT - ROAB pg. 33

b. Longer (0.5)

Reference: Westinghouse Nuclear Sources and Subcritical
Multiplication - Subcritical Multiplication
Kinetics, pg. I-4.26.
CAT-ROAB pg. 33

5.07 b (1.0)

Reference: Westinghouse Core Physics Fuel Temperature Coefficient pg. I-5.16
CAT - ROAB pg. 50

5.08 d. (1.0)

Reference: NUS, Nuclear Energy Training - Reactor Operation, p. 8.3.2

5.09 a (1.0)

Reference: NUS, Nuclear Energy Training - Reactor Operation, p. 9.2-5, p. 9.1-4

5.10 b (1.0)

Reference: NUS, Nuclear Energy Training - Reactor Operation p. 10.5 - 1-4

5.11 d (DELETED) (1.0)

Reference: NUS, Nuclear Energy Training - Reactor Operation, p. 9.5-1

5.12 a. decrease (.25)
b. increase (.25)
c. increase (.25)
d. decrease (.25)

Reference: Catawba Exam Bank, Theory, pg. 15

5.13 b (1.0)

Reference: NUS, Nuclear Energy Training - Reactor Operation, pp. 9.2-5, 11.3-2, & 11.4-3

5.14 a (1.0)

Reference: Q-RT-NMF

5.15 b (1.0)

Reference: NUS, Nuclear Energy Training - Plant Performance, Section 3.4

5.16

a. Remain the same (0.5)
b. Decrease (0.5)
c. Increase (0.5)

Reference: General Physics Co. HTFF
Fluid Flow Applications for Systems and
Components.

5.17 a. True (0.5)
b. True (0.5)

Reference: NUS, Nuclear Energy Training - Plant Performance,
p. 5-3.2

5.18 a. Inner (0.5)
b. Outer (0.5)
c. Inner (0.5)
d. Inner (0.5)

Reference: NUS, Nuclear Energy Training - Plant
Performance, pp. 10-1, 8 & 9

5.19 c (1.0)

Reference: Catawba; Q-THF-HT-18

5.20 a. Increase (0.5)
b. Increase (0.5)
c. Decrease (0.5)
d. Decrease (0.5)

Reference: General Physics, HTFF - Fluid Flow Applications
for Systems and Components

5.21 d

Reference: ROAB CAT Q-THF-ST M02 (1.0)

6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION

(ANSWERS)

6.01 a (1.0)

Reference: Q-SYS-SM-05

6.02 c (1.0)

Reference: Q-SYS-SM-02

6.03 b (1.0)

Reference: Q-SYS-NV-30

6.04 b OR d (1.0)

Reference: Q-SYS-NF

6.05 b (1.0)

Reference: Q-SYS-CLA-04

6.06 d (1.0)

Reference: Q-IC-EHC-12

6.07 a (1.0)

Reference: Q-EL-EPL

6.08 b (1.0)

Reference: Q-IC-IRE-26

6.09 b (1.0)

Reference: Q-IC-IRE-20

6.10 d (1.0)

Reference: Q-IC-IFE-07

6.11 c (1.0)

Reference: Q-IC-IPE-01

6.12 d (1.0)

Reference: Q-IC-IPE

6.13 d (1.0)

Reference: Q-IC-ENB-11

6.14 c (1.0)

Reference: Q-IC-ENB-12

6.15 c (1.0)

Reference: Q-IC-ILE

6.16 a (1.0)

Reference: Q-SYS-SM-14

6.17 a (1.0)

Reference: Q-SYS-CLA-18

6.18 (1.0)

Reference: Q-SYS-RN

6.19 d (1.0)

Reference: Q-SYS-NV-34

6.20 d (1.0)

Reference: Q-SYS-SM-03

6.21 d (1.0)

Reference: Q-SYS-NV-31

6.22 d (1.0)

Reference: Q-SYS-NS

6.23 c (1.0)

Reference: Q-SYS-KF

6.24 c (1.0)

Reference: Q-SYS-HAW

6.25 c (1.0)

Reference: CNS PSM CN-SYS-WG, pg. 4

7. Procedures - Normal, Abnormal, Emergency, and Radiological Control (ANSWERS)

7.01 (c)

Q-PRC-OP (1.0)

7.02 (b)

Q-PRC-OP (0.5)

7.03 (d)

Q-PRC-OP (1.0)

7.04 1) Manually insert rods. (1.0)
2) Locally trip reactor trip breakers.
3) Locally trip MG sets.
4) Localy trip feeder to MG sets.
5) ATWAS PROCEDURE (ANY 4 OF 5)
EP-01

7.05 1. Cause of the trip has been determined and corrective action has been completed. (0.33)

2. The reactor startup is to begin within sixteen hours after the reactor trip or unit shutdown occurred. (0.33)

3. Cooldown has not been initiated per OP/1/A/6100/02. Con trolling Procedure for Unit Shutdown). (0.33)

(ANY 3 COMBINATION OF INITIAL CONDITIONS OR PURPOSE)
Reference: Unit Fast Recovery OP/1/A/6100/05

7.06 1) Manually trip reactor. (1.5)
2) Verify reactor trip.
3) Verify turbine trip.
4) Verify 4160V Ess. switchgear energ.
5) Check SI actuated.

7.07 5%

Q-PRC-OP (0.5)

7.08 b)

Q-PRC-OP (1.0)

7.09 c)

Q-PRC-OP (1.0)

7.10	a) True	(0.5)
	b) False	(0.5)
	c) True	(0.5)
	d) False	(0.5)
	e) True	(0.5)
	Q-PRC-OP	
7.11	d)	
	Q-EL-DG-01	(1.0)
7.12	a)	
	Q-IC-IFE-02	(1.0)
7.13	d)	
	Q-SYS-VC-30	(0.5)
7.14	d)	
	Q-IC-EHC-13	(1.0)
7.15	c) (DELETED)	
	Q-CM-NCP	(1.0)
7.16	d)	
	Q-CM-SG	(0.5)
7.17	d)	
	Q-CM-SG	(1.0)
7.18	a)	
	Q-SY-2M	(1.0)
7.19	b)	
	Q-SYS-VF-16	(1.0)
7.20	b)	
	Q-SYS-VF-10	(1.0)
7.21	d)	
	Q-SYS-SM-23	(1.0)

7.22	b)	
	Q-SYS-SM-20	(1.0)
7.23	b)	
	S.D. 3.1.1	(1.0)
7.24	d)	
	Q-SYS-NV-4	(1.0)
7.25	b)	
	Q-RP-FRP	(1.0)

8. Adminsitrative Procedures, Conditions, and Limitations

8.01	False	(0.5)
	Q-IC-IFE-10	
8.02	True	(0.5)
	Q-IC-IFE-13	
8.03	False	(0.5)
	Q-SY-CLA-01	
8.04	True	(0.5)
	Q-SY-CLA-12	
8.05	d)	(1.0)
	Q-IC-EMF	
8.06	c)	(1.0)
	Q-SYS-VE-17	
8.07	b)	(1.0)
	Q-SYS-VE-15	
8.08	d)	(1.0)
	Q-SYS-VC-3	
8.09	b)	(1.0)
	Q-SYS-SM-24	
8.10	b)	(1.0)
	Q-PRC-EP	
8.11	c) DNBR < 1.3	(1.0)
	Q-PTR-AM-06	
8.12	d) Fuel Handling Accident	(1.0)
	Q-PRT-AM-01	

8.13	1. A 2. B 3. A 4. B (DELETED)	(0.5) (0.5) (0.5) (0.5)
	Tech Spec Sec. 6.9	
8.14	d)	(1.0)
	Q-AD-TS-02	
8.15	~~b)~~ a	(1.0)
	Q-AS-SEP	
8.16	a) (DELETED)	(1.0)
	Q-ENV-RGR-09	
8.17	d)	(1.0)
	Q-ENV-RGR-04	
8.18	d)	(1.0)
	Q-RAD-FRP	
8.19	b)	(1.0)
	Q-FH-FC	
8.20	a)	(1.0)
	Q-FH-FC	
8.21	b)	(1.0)
	Q-FH-FC	
8.22	c)	(1.0)
	Q-SYS-SM-10	
8.23	b)	(1.0)
	Q-SYS-NV-15	
8.24	b)	(1.0)
	Q-SY-NI-10	

8.25 d) (1.0)

Q-SYS-CLA-20

8.26 c) (1.0)

Q-SY-CLA-14

NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

(1)

Enclosure 3 (2 of 2) MASTER

U. S. NUCLEAR REGULATORY COMMISSION

REACTOR OPERATOR LICENSE EXAMINATION

Facility: Catawba
Reactor Type: PWR-W
Date Administered: _____
Examiner: E. Cook and A. Johnson
Applicant: _____

INSTRUCTIONS TO APPLICANT:

Use separate paper for the answers. Write answers on one side only. Staple questions 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 Cat. Value	Category
~~25~~ 24.5	~~25~~ 24.5	_____	_____	1. Principles of Nuclear Power Plant Operations, Thermodynamics, Heat Transfer and Fluid Flow
25	25	_____	_____	2. Plant Design Including Safety and Emergency Systems
25	25	_____	_____	3. Instruments and Controls
~~25~~ 24	~~25~~ 24	_____	_____	4. Procedures - Normal, Abnormal, Emergency & Radiological Control
~~100~~ 98.5	~~100~~ 98.5	_____	_____	TOTALS

Final Grade _____ %

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

_____
Candidate's Signature

1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATIONS, THERMODYNAMICS, HEAT TRANSFER AND FULID FLOW

TOTAL POINTS 25

1.01 Indicate how the following will affect unit efficiency at steady state power level. (Consider the affected parameter only and indicate Increase, Decrease or No Change)

(a) Absolute condenser pressure changes from 30" Hg to 25" Hg (0.5)
(b) Total S/G blowdown is changed from 35 gpm to 40 gpm (0.5)

1.02 For each of the two transients below, qualitatively explain all of the reactivity effects that cause reactor power to change throughout the transient.

In your discussion STATE whether reactor power will stabilize HIGHER THAN/LOWER THAN/or the SAME AS initial power.

ASSUME:

1. Initial power = 50%
2. Rod control is in the manual mode.
3. No operator action
4. End of core cycle
5. Turbine controls are in automatic mode
6. No reactor trip.

TRANSIENTS

a. Steam Generator PORV fails open (1.5)
b. One Band D Control rod drops (No reactor trip or Turbine Runback) (2.0)

1.03 State two reasons why equilibrium Xenon has significantly more negative worth than does equilibrium samarium in an operating reactor. (2.0)

1.04 Assuming all other DNB parameters remain constant, how will the following changes affect DNBR? (Limit your answer to INCREASES, DECREASES, or DOES NOT CHANGE DNBR).

1. Reactor thermal power increases (0.5)
2. Average RCS temperature increase (0.5)
3. RCS pressure increases (0.5)
4. RCS flow increases (0.5)

CATEGORY 1 CONTINUED ON NEXT PAGE

1.05 a. True or False

One of the pump laws for centrifugal pumps states that the volume flow rate is inversely proportional to the speed of the pump. (0.5)

b. True or False

Pump runout is the term used to describe the condition of a centrifugal pump running with no volume flow rate. (0.5)

1.06 The follow statements concern subcritical multiplication. Choose the <u>one</u> [bracketed] word that makes the statements correct.

a. As Keff approaches unity, a [larger/smaller] change in neutron level results from a given change in Keff. (0.5)

b. As Keff approaches unity, a [shorter/longer] period of time is required to reach the equilibrium neutron level for a given change in Keff. (0.5)

1.07 Although the U238 resonance capture peaks broaden and flatten with increased fuel temperature, the area under the peak remains the same. Why then is there an increase in neutron capture as the fuel temperature is increased? (1.0)

1.08 a. Explain why (MTC) moderator temperature <u>coefficient</u> becomes more negative for an increase in moderator temperature. Neglect boron effects. Rods are in manual. (1.0)

b. How <u>and</u> why does the moderator temperature coefficient (MTC) change as boron concentration is increased at a <u>constant temperature</u>. (Rods are in manual) (1.0)

1.09 If steam goes through a throttling process, specifically as in a leak from a main steam header high pressure line to atmosphere, will the following parameters <u>Increase</u>, <u>Decrease</u>, or <u>Remain the Same</u>?

1. Enthalpy (0.5)
2. Pressure (0.5)
3. Entropy (0.5)
4. Specific Volume (0.5)
5. Temperature (0.5)

CATEGORY ONE CONTINUED ON NEXT PAGE

1.10 Assume one Reactor Coolant Pump trips at 30% power, without a reactor protective system actuation or a change in turbine load. Indicate whether the following parameters will INCREASE, DECREASE or REMAIN THE SAME

a. Flow in OPERATING reactor coolant loops (0.5)
b. Affected loop S/G level INITIALLY (0.5)
c. Reactor vessel Delta P (0.5)
d. Core Delta T (0.5)
e. OPERATING LOOP steam generator pressure. (0.5)

1.11 How does each of the following parameters change (INCREASE, DECREASE, or NO CHANGE) if one main steam isolation valve closes with the plant at 50% load. Assume all controls are in automatic and that no reactor trip occurs.

a. Affected loop steam generator level (INITIAL CHANGE ONLY) (0.5)
b. Affected loop steam generator pressure (0.5)
c. Affected loop cold leg temperature (0.5)
d. Unaffected loop steam generator level (INITIAL CHANGE ONLY) (0.5)
e. Unaffected loop steam generator pressure (0.5)
f. Unaffected loop cold leg temperature (0.5)

1.12 True or False

For the same constant startup rate it takes the same time to change reactor power from 20% to 40% as it does from 40% to 60%. (0.5)

1.13 True or False

The build up of Pu-239 causes a reduction in Beff from approximately 0.007 at BOL to 0.005 at EOL. This decrease enhances the effect of a given reactivity change and causes the system to react a bit more rapidly to the changes in Keff due to the decrease in average neutron lifetime. (0.5)

1.14 True or False

(DELETED)

The production of power by fission ceases within a few seconds of a reactor trip. (0.5)

1.15 True or False

The use of a sliding Tavg program allows Catawba Nuclear Plant PWR to operate with a higher thermodynamic efficiency than does a constant Tavg program. (0.5)

CATEGORY ONE CONTINUED ON NEXT PAGE

1.16 A heat balance is run at full power and the power range channels are adjusted to read 100%. State whether indicated power would be equal to, greater than, or less than, actual power for the following conditions:

a. Indicated feedwater temperature was 10°F higher than actual. (0.5)

b. Heat output of the reactor coolant pumps was neglected in the calculation. (0.5)

1.17 The definition of sensible heat is: (choose one)

a. A unit of heat energy. The amount of energy necessary to increase the temperature of 1 lbm of water 1°F. (0.5)

b. The amount of heat necessary to change 1 lbm of saturated liquid to saturated steam.

c. The amount of heat necessary to change the temperature of 1 lbm of a particular material 1°F.

d. Heat added to or removed from a substance which results in a change in the temperature of the substance.

END OF CATEGORY 1

WRITE "END OF CATEGORY 1" ON YOU ANSWER PAGE.

2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS

TOTAL POINTS = 25

2.01 The Main Steam safety valves are used for: (Select one) (1.0)

a. Overpressure protection during the most severe postulated loss of heat sink accident.

b. Overpressure protection following the most severe postulated steam line break accident.

c. Overpressure protection following a design basis accident.

d. Overpressure protection following a S/G overfill accident.

2.02 Which one of the following is true of the S/G PORV's? (1.0)

a. Can be operated from either ASP 'A' or ASP 'B'.

b. Can be locally operated by air loader.

c. Use for cooldown during normal shutdown.

d. Used to limit safety valve actuation.

2.03 What is the purpose of the flow restrictor in the outlet of each S/G? (Select one) (1.0)

a. Provide flow to the SSPS for SM isolation on high steam flow.

b. Limits flow out of the S/G in the event of a S/G tube rupture to prevent overfill condition.

c. Limits flow out of the S/G in the event of a steam line rupture to reduce S/G thrust loading.

d. Provides flow to the SGWLC System to maintain programmed S/G pressure.

2.04 The Vacuum Priming (ZP) System services: (Select One) (1.0)

a. RN System

b. CM Hotwell

c. YM System

d. RL System

CATEGORY 2 CONTINUED ON NEXT PAGE

2.05 Which of the following is true concerning hydrogen in the VCT? (1.0)

a. It is supplied from the waste gas shutdown tanks.

b. It is maintained at 50 psig to supply proper backpressure on #2 NC pump seal.

c. It must be kept less than 30 cc/kg per tech specs.

d. It is necesary for oxygen scavenging.

2.06 The cation bed demineralizers are placed in service to control __1__ and __2__. (1.0)

a. (1) Lithium, (2) Oxygen

b. (1) Lithium, (2) Cesium

c. (1) Cesium, (2) Hydrazine

d. (1) Hydrazine, (2) Oxygen

2.07 Excess letdown taps off from which portion of the NC system? (Select one) (1.0)

a. Loop "A" Cold Leg

b. Loop "B" Cold Leg

c. Loop "C" Cold Leg

d. Loop "D" Cold Leg

2.08 The containment spray water is returned to the containment sump from the containment upper level during containment spray operation through the: (Select one) (1.0)

a. Ice Condenser lower doors

b. Divider barrier

c. Ice Condenser floor drains

d. Refueling cavity drains

CATEGORY 2 CONTINUED ON NEXT PAGE

2.09 Which one of the following is true about the Catawba ice condensers? (Select One) (1.0)

a. The Sodium Tetraborate Solution will absorb Neutrons and retain Iodine and Noble gases.

b. The Ice Bed will reduce containment peak temperature and pressure after a LOCA.

c. The Ice Bed will be at least 2200 ppm Boron as Sodium Tetraborate and a pH of 8.5 to 9.5.

d. The Ice will be contained in a minimum of 1,944 baskets and the total ice weight shall be at least 2,368,652 pounds at confidence 95%.

2.10 Which one of the following statements is true concerning the KF system? (1.0)

a. The skimmer trough is adjustable to ensure adequate suction pressure for the skimmer pump.

b. Maximum KF demineralizer prefilter D/P is 35 psid.

c. Purification loop flow shall not exceed 530 GPM.

d. Purification loop flow is adjusted by throttling the KF pump discharge valves.

2.11 Which one of the following statements concerning feedwater heater shells is true: (Select One) (1.0)

a. First stage reheater drain tank drains to "A" CF heater.

b. Second stage reheater drain tank drains to "B" CF heater.

c. Moisture Separater Reheater drain tank drains to "C" CF heater drain tank.

d. "B" CF heater drains will drain to "B" CF heater.

CATEGORY 2 CONTINUED ON NEXT PAGE

2.12 The purpose of the flow orifice in the Cold Leg Accumulator (CLA) discharge line is: (Select one) (1.0)

a. To equalize the flow to the Cold Leg Accumulators

b. To extend the blowdown time of the Cold Leg Accumulators during a loss of coolant accident.

c. To provide a method to measure the flow from the CLA's during a loss of coolant accident.

d. To provide a method to measure flow when testing both CLA discharge check valves for leakage.

2.13 Which one of the following statements is true? (1.0)

a. Loss of two Hotwell Pumps will directly trip one Feed Pump Turbine.

b. Loss of two Booster Pumps will directly trip one Feed Pump Turbine.

c. Loss of three Booster Pumps will directly trip one Feed Pump Turbine.

d. Loss of three Booster Pumps will directly trip two Feed Pump Turbines.

2.14 The sources of water to the CA System in order of preference of use are: (Select One) (1.0)

a. CACST; Hotwell; YM; YF; RN

b. CACST; UST; Hotwell; RN; RC

c. CACST; CST; UST; RN; RL

d. FWST; RMWST; CACST; RN; RC

2.15 The source of water for the Exhaust Hood Spray is the: (Select One) (1.0)

a. CM Pump discharge

b. Condensate Booster Pump discharge

c. Exhaust Hood Spray Pump discharge

d. Upper Surge Tank Riser

CATEGORY 2 CONTINUED ON NEXT PAGE

2.16 From the statements below, concerning the rod control system, indicate which statement is incorrect. (No explanation is necesary.) (1.0)

a. The programmed Tavg is increased linearly with power.

b. The nonlinear gain unit adjusts circuit gain depending on reactor power.

c. The bank overlap unit tells the slave cycler which master cycler to send the signal to for rod motion.

d. The rod drive mechanisms receive their power from two parallel motor generator sets through two series Reactor Trip Breakers.

2.17 Which one of the following is a function of the EHC system? (1.0)

a. Maintain constant load for steam dump failures <10% F. P.

b. Maintain grid frequency +0.3HZ for all normal reactor power level changes.

c. Allows reactor trip from 100% load without lifting the ASME Code main steam safety valves.

d. Prewarming of the steam chest and turbine rotor.

2.18 Which one of the following is a design purpose of the Area Radiation Monitoring System as presented in the Catawba Plant Summary Manual? (1.0)

a. Indicate activity buildup in the reactor coolant filters.

b. Monitor primary and secondary systems within the station during normal operation, including anticipated operation occurrences (equipment failure, misoperation, etc.)

c. Provide continuous monitoring of radioactive liquid and gas discharge to the environment.

d. Provide interlocks to automatically terminate discharge from waste systems at preset activity levels.

CATEGORY 2 CONTINUED ON NEXT PAGE

2.19 The diesel generator is taken out of the "Maintenance Mode" by: (Select One) (1.0)

a. The operator at the local panel and the control room operator depressing both "Maintenance Mode" pushbuttons simultaneously.

b. The operator at the local panel engaging the barring gear.

c. The operator at the local panel disengaging the barring gear.

d. The operator at the local panel resetting the lockout relay.

2.20 Which one of the following statements is true regarding the Vital I & C standby battery charger: (Select One) (1.0)

a. Only one output breaker can be shut at one time.

b. Input sources must be synchronized prior to closing a second input breaker.

c. It is normally fed from two MCCs in parallel.

d. They perform as inverters upon loss of AC power.

2.21 Which one of the following statements is <u>incorrect</u> (1.0)

a. The UHI accumulator should be sampled for boron concentration if greater than 1% increase in total volume occurs.

b. Insure UHI discharge isolations are fully open when the NC pressure exceeds 1400 psig.

c. UHI N2 accumulator fill isolation will auto close should N2 inlet temperature decrease to 65 degree F.

d. Normal level in the UHI surge tank is 50% -70%.

2.22 Which one statement is true of the Instrument Air System? (Select One) (1.0)

a. The base compressor shuts down at 100 psig.

b. The base compressor starts at 92 psig.

c. The standby compressor starts at 88 psig.

d. Station air is supplied to VI at 80 psig.

CATEGORY 2 CONTINUED ON NEXT PAGE

2.23 The VE system maintains a vacuum on the annulus by: (Select one) (1.0)

a. Discharging a portion of the annulus air to the unit vent through automatic dampers.

b. Discharging all of the annulus air to the unit vent through normally open dampers.

c. Recirculating of the annulus air through coolers.

d. Discharging a portion of the annulus air to the unit vent by manually controlled dampers.

2.24 Two conditions must be met in the VF system to allow the supply fan to start. One of these is the switch for the supply fan is in "AUTO". The other condition is: (Select One) (1.0)

a. One exhaust fan in each train must be on with a D/P seen by the exhaust circuit.

b. No alarm on EMF-42

c. Two exhaust fans on in either train with a D/P seen by the exhaust circuit.

d. Any combination of two exhaust fans on with a D/P seen by the exhaust circuit.

2.25 When performing a smoke purge of the control room, the smoke purge fan will be started: (Select One) (1.0)

a. Automatically by the smoke detector

b. By the operator from ICRA-ECP-1

c. By the operator from the main HVAC panel

d. Automatically by the fire detection system

END OF CATEGORY 2

WRITE "END OF CATEGORY 2" ON YOUR ANSWER SHEET

3. INSTRUMENTS AND CONTROLS

TOTAL POINTS = 25

3.01 Identify which one of the following statements is true for the Catawba Radiation Monitoring System. (1.0)

a. EMF-31 utilizes a gamma scintillation detector; it's designated "condenser air"; it monitors activity from the air ejector exhaust and it is located near the Turbine Building sump.

b. EMF-41 utilizes a beta scintillation detector; it's designated "Aux. Bldg. Vent."; it monitors 12 points in AB filtered exhaust system, secures bypass around AB filter units and places them in service; and it is located near NC filters on 560 level corridor.

c. EMF-41 utilizes a beta scintillation detector; it's designated "VUCDT discharge"; it closes the drain tank outlet valve (WL873); and it is located near "B" VF exhaust filters.

d. EMF-49 utilizes a beta scintillation detector; it's designated "Floor Drains"; it diverts flow from CA sump and floor drain sump to FDT by closing WL848 and opening WL847; and is located near the unit vent on the 594 level.

3.02 Which on of the following reactor control system auto-rod control setpoints is in agreement with those stated in the Catawba Plant Summary Manual? (1.0)

a. dead band 2.0 degree F

b. lock up 0.5 degree F

c. min. speed 30"/min.

d. max. speed 64 steps/min.

3.03 Which one of the following control systems would <u>not</u> be directly affected by a T-hot RTD failed high? (1.0)

a. Steam dump control

b. Steam generator level control

c. Rod Control

d. Pressurizer level control

CATEGORY 3 CONTINUED ON NEXT PAGE

3.04 While operating at 100% power, power range channel NI-41 fails low. The response of the S/G level control system will be: (Choose one) (1.0)

a. If the channel is controlling S/G A and D, B and C level will increase to 66%.

b. If the channel is controlling S/G B and C, A and D level will decrease to 38% level which will result in a S/G Lo-Lo level reactor trip.

c. No effect upon the system.

d. Channel I trip setpoint for all four S/G's will be reduced to ~~18%~~ 17%.

3.05 Which one of the following statements regarding Reactor Trip System Interlocks is true? (1.0)

a. On decreasing power, P-6 allows the manual restoration of the source range level trips and source range high voltage.

b. 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 low pressure, and pressurizer high level.

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

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

3.06 The pressurizer level control system is primarily designed to: (Select One) (1.0)

a. Provide protection for the reactor coolant system against low pressure DNB

b. Limit changes in reactor coolant system pressure during all modes of unit operation.

c. Provide satisfactory operation without a reactor trip during load increases or decreases at 10% of full power per minute.

d. Maintain water level in the pressurizer within an acceptable program range under all load conditions during operation.

CATEGORY 3 CONTINUED ON NEXT PAGE

3.07 Indicate which of the following statements is true concerning the construction and operation of the Power Range N.I. detector. (No explanation is required.) (1.0)

a. Has Boron-Trifluoride (BF_3) gas in the outer volume of the detector but not in the inner volume.

b. Has Boron-Trifluride (BF_3) gas in both inner and outer volumes of the detector.

c. Operates in the proportional region of the gas amplification curve (detector current vs. voltage curve).

d. Uses no compensation circuitry to remove gamma current.

3.08 Which one of the following protective features associated with excore NI's can be completely blocked or bypassed? (1.0)

a. PR high flux high setpoint trip

b. PR positive rate trip

c. PR high flux low setpoint trip

d. Overpower delta T trip

3.09 A small leak in the pressurizer reference leg drops the level in the reference leg by 10 inches. Indicated pressurizer level will: (Select one) (1.0)

a. Drop by 10 inches.

b. Drop by 20 inches.

c. Increase by 10 inches.

d. Not change.

3.10 What two items best describe the possible failures of a differential pressure transmitter which can cause a low delta reading: (Select one) (1.0)

a. Bellows rupture or high pressure side line ruptured

b. Equalizing line closed or low pressure side line ruptured

c. Bellows ruptured or equalizing line open

d. Equalizing line closed or high pressure side line ruptured

CATEGORY 3 CONTINUED ON NEXT PAGE

3.11 Which one of the following statements regarding the Digital Rod Position Indication System is accurate? (1.0)

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.

3.12 During a release from containment using the VQ system, which one of the following signals will automatically secure release? (1.0)

a. Containment pressure of 25 psig

b. Sp signal

c. EMF-39 Containment gaseous monitor

d. EMF-36 Unit vent gaseous monitor

3.13 Which of the following EMF's will cause the VF system filters to be placed in service? (Select one) (1.0)

a. EMF-35, 36, 37 Unit Vent Monitors

b. EMF-17 Rx Bldg. Manipulator Crane

c. EMF-15 Spend Fuel Bldg:

d. EMF-42 Fuel Bldg. Ventilation

3.14 The S/G PROV Setpoints are: (1.0)

a. Open 1125 psig, close 1065 psig

b. Open 1165 psig, close 1025 psig

c. Open 1065 psig, close 1025 psig

d. Open 1125 psig, close 1025 psig

CATEGORY 3 CONTINUED ON NEXT PAGE

3.15 Which one of the following will cause a Main Steam Isolation? (1.0)

a. Safety Injection Signal (S_S)

b. Phase 'A' Isolation Signal (S_T)

c. Hi-Hi Containment Pressure Signal

d. Hi Steam Flow Rate

3.16 Automatic makeup to the VCT begins at __(1)__ level and secures at __(2)__ level. (1.0)

a. (1) 41%, (2) 54%

b. (1) 41%, (2) 56%

c. (1) 38%, (2) 54%

d. (1) 38%, (2) 56%

3.17 The control for the _____ is used to control secondary pressure during turbine shell warming. (Select one) (1.0)

a. MSR drain tank vents

b. Intercept valves

c. MSR shell drains

d. Extraction line drains

3.18 As water level rises in the MSR drain tank, the turbine will trip when level reaches: (Select one) (1.0)

a. High setpoint

b. + 4 inches above normal level

c. Emergency high level

d. Into the MSR shell

TEGORY 3 CONTINUED ON NEXT PAGE

3.19 If power is connected to the Cold Leg Accumulator (CLA) outlet isolation valves they will (select one) (1.0)

a. Automatically close when control is swapped to the Auxiliary Shutdown panel.

b. Automatically close on a Lo-Lo level in the respective CLA with an S_S signal present.

c. Automatically close when the reactor coolant system decreases below P-11 (1955 psig).

d. Automatically close on a low steam line pressure safety injection signal since the CLA's are not required for a steam break accident.

3.20 With Train 'A' VC-YC in operation, powered from Unit 1, an S_S signal is received. The response of the VC-YC system will be: (Select one) (1.0)

a. Train A will remain running and Train B CR-AHU and pressure filter fan will start.

b. Train A will remain running and Train B CR-AHU and CRA-AHU will start.

c. Train A will remain running.

d. Train B will auto start and Train A will continue running.

3.21 Low range process monitors (EMF's) normally utilize __1__ detectors, while the high range utilizes a __2__ detector. (Choose one) (1.0)

a. (1) Alpha scintaillation (2) G-M

b. (1) G-M (2) Beta scintillation

c. (1) Ion chamber (2) G-M

d. (1) Scintillation (2) G-M

CATEGORY 3 CONTINUED ON NEXT PAGE

3.22 Following an ESFA signal, which one of the following statements is true concerning the RN system? (Select one) (1.0)

a. The non-essential header is isolated.

b. The channel cross-overs close.

c. All RN pumps start.

d. The diesel generators supply the RN pumps.

3.23 Choose the correct response of the NV system to an S_S signal. (1.0)

a. All charging pumps start

b. Excess letdown isolates

c. Auxiliary pressurizer spray isolates

d. Boric acid pumps start

3.24 Lo-Lo level switch on the Glycol Expansion Tank will: (Select One) (1.0)

a. Close two containment isolations.

b. Trip the Glycol pumps

c. Auto start the Glycol Mixing and Storage Tank pump

d. Turn on heat tracing to expand the Glycol.

3.25 Which one of the following is not a direct containment isolation signal? (1.0)

a. S_P

b. S_T

c. S_S

d. S_H

END OF CATEGORY 3

WRITE "END OF CATEGORY 3" ON YOUR ANSWER SHEET

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL
TOTAL POINTS = 25

4.01 During a plant cooldown the operator must: (select one) (1.0)

a) Lock out the NI pumps when cold leg temperature is below 400°F.

b) Be prepared to manually initiate safety injection if the plant is above P-11.

c) Borate NC to value found using Unit Shutdown Procedure prior to blocking NI.

d) Block NI when NC pressure drops below 1,950 psig.

4.02 During a plant start up while forming a steam bubble in the pressurizer, the level is maintained at _____ per cent. (select one) (0.5)

a) 100
b) 95
c) 62
d) 25

4.03 During a plant start up while forming a steam buble in the pressurizer the nitrogen blanket in the pressurizer has to be vented. Nitrogen venting of the pressurizer is considered to be complete when: (select one) (1.0)

a) PRT pressure increase with a corresponding decrease in pressurizer level.

b) PRT pressure increases with a corresponding decrease in the PRT level.

c) PRT pressure does not increase with a corresponding increase in pressurizer level.

d) PRT pressure does not increase with a corresponding increase in PRT level.

4.04 List the four (4) actions required in EP-01 reactor trip or SI if the reactor fails to trip. (1.0)

4.05 State the three required plant conditions which must be met for returning the reactor unit to power, following a reactor trip, by the "Unit Fast Recovery" procedure OP/1/A/6100/05. (1.0)

CATEGORY 4 CONTINUED ON NEXT PAGE

4.06 List the five (5) immediate actions, assuming all expected responses are obtained, for EP-01, "Reactor Trip or Safety Injection." (1.5)

4.07 Above _____% power if CF is lost to the S/G's, the operator is instructed to manually trip the reactor. (0.5)

4.08 What action is required during a reactor start up if criticality is attained below the control rod Tech. Spec. insertion limit? (Select one) (1.0)

a) Emergency borate and continue withdrawing control banks to maintain criticality, until the control banks are above their Tech. Spec. insertion limit.

b) Immediately borate and continue withdrawing control banks to maintain criticality, until the control banks are above their Tech. Spec. insertion limit.

c) Insert all control banks and notify the Reactor Group Unit Engineer or Performance section Duty Engineer.

d) Stop withdrawing rods and recheck ECP calculations are not in error, contact the Reactor Group Unit Engineer or the Performance Duty Engineer.

4.09 During a steam generator tube rupture, concurrent with a loss of off-site power, the most desirable heat sink is: (Select One) (1.0)

a) Main condenser.

b) Letdown heat exchanger.

c) Steam generator PORVs.

d) Pressurizer PORVs.

CATEGORY 4 CONTINUED ON NEXT PAGE

4.10 Indicate if each of the statements below are True or False. (2.5)

a) All shutdown banks must be fully withdrawn before the reactor is brought critical.

b) Flux multiplication rates should not be permitted to exceed 2 decades/minute administrative limit.

c) If steam dump is actuated, steam dump control should not be reset manually until equilibrium conditions are established.

d) The automatic safety injection signal from low pressure will be automatically unblocked when RCS pressure is below 1955 psig.

e) Premissive circuit P-6 setpoint is 1×10^{-10} amps.

4.11 The proper method to startup and parallel a Diesel Generator is: (1.0)
(select one)

a) Voltages are equal, breaker is closed at 12 o'clock with the sync needle rotating rapidly in the fast direction.

b) Diesel Generator voltage lower than grid voltage, breaker is closed at 12 o'clock with the sync needle rotating slowing in the slow direction.

c) Voltages are equal, breaker is closed at 12 o'clock with the sync needle rotating slowly in the slow direction.

d) Voltages are equal, breaker is closed at 12 o'clock with the sync needle rotating slowly in the fast direction.

4.12 Steam generator level is maintained at the proper value by: (1.0)
(select one)

a) Modulating the main feedwater regulating valves above 15% power.

b) The feed regulating bypass valves up to 15% power, and when they are fully open, the main feedwater regulating valves take over.

c) The feed water regulating bypass valves up to 29% power.

d) Varying feedwater pump speed based on the rate of decrease of level in the steam generator.

CATEGORY 4 CONTINUED ON NEXT PAGE

4.13 All unit and security computers are to be secured if computer room temperature exceeds _____°F. (Select one) (0.5)

a) 95°F
b) 80°F
c) 78°F
d) 85°F

4.14 Which one of the following correctly states a limit/precaution of the Catawba Turbine Control (EHC) system? (1.0)

a) Operation below 5% load should be kept to a minimum to prevent motoring of the unit.

b) Bearing oil temperature rise across the main bearings should not exceed 110 degree F.

c) The turbine should not be operated with condenser vacuum less than 21.8 inches Hg.

d) Do not allow Turbine Generator speed to exceed 2010 rpm on overspeed tests.

4.15 Prior to racking out a Reactor Coolant Pump Breaker, the operator wishes to remove control power to the breaker. To do this, the operator must: (Select One) (1.0)

(DELETED)

a) Remove the control power fuses from the control room back panel.

b) Remove one set of fuses from inside the breaker cabinet.

c) Remove two sets of fuses from inside the breaker cabinet.

d) Place the pump control switch in pull to lock.

4.16 The temperature of both the reactor and secondary coolants in the steam generators shall be greater than _____ when the pressure of either coolant in the steam generator is greater than 200 psig (select one) (0.5)

a) (1) 212°F

b) (1) 350°F

c) (1) 160°F

d) (1) 70°F

CATEGORY 4 CONTINUED ON NEXT PAGE

4.17 When the steam generators are in wet layup, steam generator level is maintained: (select one) ((1.0)

a) Up to the outlet nozzles to minimize corrosion.

b) 14 feet below the nozzles to minimize steam generator support stress.

c) At the program level for 0% power.

d) Four feet below the outlet nozzles the protect the steam line pipe hangers.

4.18 With a decreasing condenser vacuum, the turbine MUST be tripped if: (select one) (1.0)

a) Exhaust hood temperature is 230°F.

b) Condenser Vacuum is 23"HG.

c) Condenser circulation water outlet temperature is 103°F.

d) ZP system is out of service.

4.19 When a fire is indicated on the fuel pool ventilation system filter bed, the operator should: (select one) (1.0)

a) Ensure auto trip occurs on exhaust fan, dispatch operator to open deluge valve.

b) Trip the exhaust fan, dispatch an operator to open the deluge valve.

c) Ensure exhaust fan auto trips, open the deluge valve from the fire protection panel.

d) Trip the exhaust fan, ensure deluge valve auto opens.

4.20 Following VE system auto start, what action must the operator take to secure the system? (select one) (1.0)

a) Reset the sequencer, verify the fans automatically stop

b) Reset the sequencer, depress stop pushbuttons for fans

c) Depress stop pushbuttons for the fans

d) Verify the fans stop after the initiating signal has cleared

CATEGORY 4 CONTINUED ON NEXT PAGE

4.21 While at low power level, steam withdrawal from the S/G must be slow. What is the reason for this precaution? (1.0)

a) Prevent receiving a high steam line flow MSIV closure.

b) Prevent the core from going critical.

c) Prevent reactor power from increasing.

d) Prevent reducing Tave below 551°F.

4.22 During the preformance of the MSIV movement PT, the MSIV's should move to what position? (1.0)

a) 90% closed

b) 90% open

c) 10% open

d) 50% closed

4.23 During removal of safety tags for testing, tags shall not be be lifted under any circumstances for more than (Select one) (1.0)

a) 72 hours

b) 24 hours

c) 12 hours

d) 8 hours

CATEGORY 4 CONTINUED ON NEXT PAGE

4.24 Which one of the following should be done if letdown isolates and cannot be regained. (1.0)

a) Cycle the reactor vessel head vents as needed to maintain pressurizer level at disired value.

b) Secure pressurizer heaters to prevent high pressurizer pressure due to higher pressurizer level.

c) Secure all charging pumps to prevent overfill of the pressurizer.

d) Reduce charging flow to supply NC Pump seals, secure normal charging, and establish excess letdown.

4.25 What is your maximum quarterly whole body exposure limit which you could receive without an approved extension? (Select one) (DUKE POWER) (1.0)

a. 1250 Millirem
b. 1000 Millirem
c. 3000 Millirem
d. 500 Millirem

END OF CATEGORY 4

WRITE "END OF CATEGORY 4" ON YOUR ANSWER SHEET

MASTER

PRINCIPLES OF NUCLEAR PLANT OPERATIONS, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW

(ANSWERS)

1.01 a. Decrease (0.5)
b. Decrease (0.5)

Reference: General Physics Company HTFF February 1981, Section 1.6
Typical PWR Cycle
CAT - ROAB pg. 3 - ROAB pg. 9

1.02 a. 1. + reactivity: from the lowered RCS temp. (0.5)
2. - Reactivity: from increased fuel temp. (power increase) (0.5)
3. Power stabilizes at a higher level (0.5)

b. 1. - reactivity: from dropped rod (0.5)
2. + reactivity: from the decreased fuel temp. (0.5)
(power decrease)
3. - reactivity: from the increased fuel temp. (0.5)
(as power is turned and increases)
4. Power stabilizes at the same level (0.5)

Reference: Westinghouse PWR core physics - Reactivity Coefficients
CAT - ROAB pg. 19

1.03 The production of Xe from fission and decay is greater. (1.0)
The absorption cross section for Xe is much higher. (1.0)

Reference: Westinghouse PWR Core Physics pg. I-5.63 and I-5.77

1.04 1. Decreases (0.5)
2. Decreases (0.5)
3. Increases (0.5)
4. Increases (0.5)

Reference: General Physics Company Rx PWR Limits pg. 243
General Physics Company Boiling Heat Transfer pg. 122
CAT - ROAB pg. 2

1.05 a. False (0.5)

Reference: General Physics HTFF Pump laws pg 322
CAT - ROAB pg. 13

b. False (0.5)

Reference: General Physics Company Pump Terminology pg. 320
CAT - ROAB pag. 13

1.06 a. Larger (0.5)

Reference: Westinghouse Nuclear Sources and Subcritical Multiplication - Relationship Between Subcritical Multiplication and Keff pg. I-4.13
CAT - ROAB pg. 33

b. Longer (0.5)

Reference: Westinghouse Nuclear Sources and Subcritical Multiplication - Subcritical Multiplication Kinetics, pg. I-4.26
CAT - ROAB pg. 33

1.07 The neutron sees a significant absorption cross section over a wider range of energies, and there is a reduction in the self shielding of the fuel. (1.0)

Reference: Westinghouse Core Physics Fuel Temperature Coefficient pg. I-5.16
CAT - ROAB pg. 50

1.08 a. The density change per degree -F is greater at higher temperatures (0.5)

Reference: Westinghouse PWR Core Physics Moderator Coefficient pg. I-5.8
CAT - RX TH pgs. 5, 6

b. MTC becomes less negative (decreases). The number of boron atoms (poison) in the core decreases more per °F change at higher boron concentration. (0.5) (0.5)

Reference: Westinghouse PWR Core Physics Moderator Coefficient I-5.10
CAT - RX TH pgs. 5, 6

1.09 1. Remain the same (0.5)
2. Decrease (0.5)
3. Increase (0.5)
4. Increase (0.5)
5. Decrease (0.5)

Reference: Fundamentals of Classical Thermodynamics, pg. 134
Gordon J. Van Wylen
Richard E. Sonntag 1976
CAT - ROAB pg. 6

1.10 a. Increase (0.5)
b. Decrease (0.5)
c. Decrease (0.5)
d. Increase (0.5)
e. Decrease (0.5)

Reference: General Physics Company HTFF
Fluid Flow Applications for System and Components.
CAT - THERMO - FORM

1.11 a. Decrease (0.5)
b. Increase (0.5)
c. Increase (0.5)
d. Increase (0.5)
e. Decrease (0.5)
f. Decrease (0.5)

Reference: General Physics Company HTFF
Fluid Flow Applications
CAT - THERMO - FORM

1.12 False (0.5)

Reference: CAT - ROAB pg. 208

1.13 True (0.5)

Reference: CAT - ROAB pg. 36

1.14 False (DELETED) (0.5)

Reference: HBR SES 44/WBNP QB #11
CATAWBA C.A.F.

1.15 True (0.5)

Reference: CAT - ROAB pg. 3

1.16 a. Less than (0.5)

b. Greater than (0.5)

Reference: CAT - ROAB pg. 3
CAT - ROAB pg. 7

1.17 d (0.5)

Reference: Q-THF-STM-05

2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS

(Answers)

2.01 a (1.0)

Reference: Q-SYS-SM-05

2.02 d (1.0)

Reference: Q-SYS-SM-03

2.03 c (1.0)

Reference: Q-SYS-SM-02

2.04 d (1.0)

Reference: Q-SYS-RC

2.05 d (1.0)

Reference: Q-SYS-NV-31

2.06 b (1.0)

Reference: Q-SYS-NV-30

2.07 c (1.0)

Reference: Q-SYS-NV-20

2.08 d (1.0)

Reference: Q-SYS-NS

2.09 b OR d (1.0)

Reference: Q-SYS-NF

2.10 c (1.0)

Reference: Q-SYS-KF

2.11 c (1.0)

Reference: Q-SYS-HAW

2.12 b (1.0)

Reference: Q-SYS-CLA-04

2.13 d (1.0)

Reference: Q-SYS-CM

2.14 b (1.0)

Reference: Q-SYS-CA

2.15 a (1.0)

Reference: Q-CM-MT

2.16 c (1.0)

Reference: Q-IC-IRE-23

2.17 d (1.0)

Reference: Q-IC-EHC-12

2.18 a (1.0)

Reference: Q-IC-EMF-04

2.19 d (1.0)

Reference: Q-EL-DG

2.20 a (1.0)

Reference: Q-EL-EPL

2.21 ~~a~~ b (1.0)

Reference: Q-SYS-CM

2.22 c (1.0)

Reference: Q-SYS-VI

2.23 a (1.0)

Reference: Q-SYS-VE-02

2.24 c (1.0)

Reference: Q-SYS-VF-14

2.25 b (1.0)

Reference: Q-SYS-VC-23

3. INSTRUMENTS AND CONTROLS

(Answers)

3.01 b (1.0)

Reference: Q-IC-EMF-03

3.02 b (1.0)

Reference: Q-IC-IRE-26

3.03 b (1.0)

Reference: Q-IC-IRE-20

3.04 d (1.0)

Reference: Q-IC-IFE-07

3.05 c (1.0)

Reference: Q-IC-IPE-01

3.06 d (1.0)

Reference: Q-IC-IPE

3.07 d (1.0)

Reference: Q-IC-ENB-11

3.08 c (1.0)

Reference: Q-IC-ENB-12

3.09 c (1.0)

Reference: Q-IC-ILE

3.10 c OR a (1.0)

Reference: Q-IC-ILE-02

3.11 a (1.0)

Reference: Q-IC-EDA-10

3.12 d (1.0)

Reference: Q-SYS-VQ-03

3.13 d (1.0)

Reference: Q-SYS-VF-22

3.14 a (1.0)

Reference: Q-SYS-SM-14

3.15 c (1.0)

Reference: Q-SYS-SM-11

3.16 a (1.0)

Reference: Q-SYS-NV-11

3.17 c (1.0)

Reference: Q-SYS-MSR-14

3.18 d (1.0)

Reference: Q-SYS-MSR-13

3.19 a (1.0)

Reference: Q-SYS-CLA-18

3.20 a (1.0)

Reference: Q-SYS-VC-19

3.21 d (1.0)

Reference: Q-ENV-RGR-06

3.22 (1.0)

Reference: Q-SYS-RN

3.23 d (1.0)

Reference: Q-SYS-NV-34

3.24 a (1.0)

Reference: Q-SYS-NF-16

3.25 c (1.0)

Reference: Q-IC-ISE-20

4. Procedures - Normal, Abnormal, Emergency, and Radiological Control (ANSWERS)

4.01 (c) (1.0)

Q-PRC-OP

4.02 (b) (0.5)

Q-PRC-OP

4.03 (d) (1.0)

Q-PRC-OP

4.04 1) Manually insert rods. (1.0)
2) Locally trip reactor trip breakers.
3) Locally trip MG sets.
4) Localy trip feeder to MG sets.
5) ATWAS PROCEDURE (ANY 4 OF 5)
EP-01

4.05 1. Cause of the trip has been determined and corrective action has been completed. (0.33)

2. The reactor startup is to begin within sixteen hours after the reactor trip or unit shutdown occurred. (0.33)

3. Cooldown has not been initiated per OP/1/A/6100/02. Controlling Procedure for Unit Shutdown). (0.33)

(ANY 3 COMBINATION OF INTIAL CONDITIONS OR PURPOSE)
Reference: Unit Fast Recovery OP/1/A/6100/05

4.06 1) Manually trip reactor. (1.5)
2) Verify reactor trip.
3) Verify turbine trip.
4) Verify 4160V Ess. switchgear energ.
5) Check SI actuated.

4.07 5% (0.5)

Q-PRC-OP

4.08 b) (1.0)

Q-PRC-OP

4.09 c) (1.0)

Q-PRC-OP

4.10	a) True	(0.5)
	b) False	(0.5)
	c) True	(0.5)
	d) False	(0.5)
	e) True	(0.5)
	Q-PRC-OP	
4.11	d)	(1.0)
	Q-EL-DG-01	
4.12	a)	(1.0)
	Q-IC-IFE-02	
4.13	d)	(Typo) (0.5) ~~(1.0)~~ Found before review.
	Q-SYS-VC-30	
4.14	d)	(1.0)
	Q-IC-EHC-13	
4.15	c) (DELETED)	(1.0)
	Q-CM-NCP	
4.16	d)	(0.5)
	Q-CM-SG	
4.17	d)	(1.0)
	Q-CM-SG	
4.18	a)	(1.0)
	Q-SY-2M	
4.19	~~a~~ b (Typo) Found before review.	(1.0)
	Q-SY-ZM	
4.20	b)	(1.0)
	Q-SYS-VF-16	
4.21	d)	(1.0)
	Q-SYS-SM-23	

4.22	b)	(1.0)
	Q-SYS-SM-20	
4.23	b)	(1.0)
	S.D. 3.1.1	
4.24	d)	(1.0)
	Q-SYS-NV-4	
4.25	b)	(1.0)
	Q-RP-FRP	