ENCLOSURE 1

EXAMINATION REPORT - 50-335, 389/OL-85-01

Facility Licensee: Florida Power and Light Company

Facility Name: St. Lucie

Facility Docket Nos. 50-335 and 50-389

Written and oral examinations were administered at St. Lucie near Ft. Pierce, Florida.

Chief Examiner: A. H. Johnson — 5/13/85 Date Signed

Approved by: W. G. Douglas for Bruce A. Wilson, Section Chief — 5/13/85 Date Signed

Summary:

Examinations on February 11 - 13 and March 5, 1985

Oral examinations were administered to ten candidates, all of whom passed. Eight candidates were administered written examinations, seven of whom passed.

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PDR ADOCK 05000335
Q PDR

REPORT DETAILS

1. Facility Employees Contacted:

*P. Fincher, Plant Training Supervisor
*M. Sheppard, Operations Training Supervisor
*J. Spodick, Training Coordinator
*R. Weller, Training Coordinator

*Attended Exit Meeting

2. Examiners:

*A. H. Johnson
J. W. Upton
J. D. Smith

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners met with J. Spodick and R. Weller to review the written examination and answer key. The following comments were made by the facility reviewers:

a. SRO Exam

1. Question 5.03

Facility Comment: Answer should be C not D due to assumption of a constant Tavg; therefore, no net reactivity added and nuclear power remains constant.

NRC Resolution: Facility comment accepted and answer key changed to C.

2. Question 5.04

NRC Change: Prior to the examination, the answer key was changed from 494 ppm to 439 ppm, after reviewing the curve which was previously misread.

3. Question 5.07

NRC Change: This question was deleted prior to the start of the examination because the curve was misread in developing the question and thereby, not allowing a correct answer.

4. Question 5.17

Facility Comment: C is a correct answer in addition to A.

NRC Resolution: Facility comment accepted. The change in enthalpy cannot be determined across turbine/condenser. A and C acceptable answers.

5. Question 5.19

Facility Comment: To arrive at correct answer you require assumptions to be made; however, question states "evidenced by itself." Recommend deletion.

NRC Resolution: Delete question. Not enough information given. For example, "feedwater flow constant with steam generator level increasing."

6. Question 5.20.b

Facility Comment: Question should read "Heat-up" not heat stress.

NRC Resolution: Agree with facility comment. Question b deleted due to typo, where heat stress should be heat-up stress.

7. Question 5.21

Facility Comment: All the terms used in the question are not all used in the training program. Recommend deletion.

NRC Resolution: Agree with facility comment. Question deleted.

8. Question 5.22

Facility Comment: All the terms used in the question are not all used in the training program. Recommend deletion.

NRC Resolution: Agree with facility comment. Question deleted.

9. Facility General Comment on Section 5:

Too many NUS questions using terms not used at St. Lucie and therefore, unfamiliar to the majority of operators.

NRC Response: If the St. Lucie facility furnished the appropriate theory reference material, the general theory reference material would not have to be used.

10. Question 6.02

Facility Comment: Answer B in addition to D are correct answers.

NRC Resolution: Off-Normal Procedure "Loss of Instrument Air" verifies answer B. Either choice B or D accepted as correct answer.

11. Question 6.11

Facility Comment: First three answers (A, B, and C) are all incorrect.

NRC Resolution: Question deleted. Main Power Distribution System Unit 1 drawing verifies facility comment.

12. Question 6.10 and 6.12

Facility Comment: Very similar questions, possible double jeopardy.

NRC Resolution: Different testing objectives; therefore, no double jeopardy.

6.10 was testing for RRS differences between Units 1 and 2.

6.12 was testing for pressurizer input.

13. Question 6.18

Facility Comment: Answer C in addition to B is correct.

NRC Resolution: Diesel Generator Periodic Test, 2-2200050, Rev. 7 verifies answer C. Either choice B or C accepted. System Description not updated to reflect both locations.

14. Question 6.25

Facility Comment: Answer A is correct for Unit 2; however, not included in answer key.

NRC Resolution: Agree with facility comment. Lecture Outline 46 verifies that A and B are acceptable answers.

15. Question 7.06

Facility Comment: Answer C in addition to D is correct.

NRC Resolution: Accept answer C or D, because shutdown cooling is not in service at 100% power.

16. Question 7.09

Facility Comment: Step 2 on auto actions incorrect, since question states "no reactor trip."

NRC Resolution: Step 2 of auto actions not required as answer without a reactor trip. Answer key and category score changed to reflect this.

17. Question 7.11.d

Facility Comment: The ICC procedure has been deleted. The difference that existed in procedures between Unit 1 and 2 were an omission on part of facility and not a difference between the units.

Resident Inspector verified Inadequate Core Cooling (ICC) was deleted. EP No. 2-0030143, "Total Loss of AC Power," shows verification of natural circulation to be subsequent action.

See NRC Resolution of 7.12 regarding comment on procedural differences between units.

18. Question 7.12

Facility Comment: We recognize that a deficiency exists between the two units in procedures. The intent of the procedures are the same, and the basic actions are the same. We feel that to differentiate based on wording is consistent with the desire to fairly test the license candidates. We will correct this deficiency.

NRC Resolution: Reference FP&L letter dated December 29, 1983, to James P. O'Reilly, Regional Administrator, Region II. In this letter it was stated that:

> Procedures. All Units 1 and 2 Administrative, Operating, Off-Normal, and Emergency Procedures, have been reviewed and revised as necessary in order to make them as similar and consistent as possible. In addition, both Unit's Emergency Operating Procedures have been revised into the same up-graded (two-column) format.

We subsequently based our decision to allow dual licensing of St. Lucie personnel, in part, on the consistency of procedures between the two units.

When preparing these examinations, the examiner noted the differences in Immediate Actions for Emergency Procedures EP1/2-0030141 (Control Room Inaccessibility), EP1/2-0120043 (Inadequate Core Cooling) and EP1/2-0250030 (Emergency Boration). We assumed these differences were intentional and probably due to system differences between Units 1 and 2. Since these procedures were in effect at the time of examination, this question and answer remain unchanged.

19. Question 7.14

Facility Comment: B and D are both acceptable answers to the question as stated.

NRC Resolution: Answer D is not accepted. Reason is stated in answer key.

20. Question 8.03.c

Facility Comment: Electrical conditions could be assumed to be loss of all AC. In this case, could get General Emergency for an answer.

NRC Resolution: If this assumption is made by candidates, grading will reflect correct analysis based on assumption.

21. Question 8.08

Facility Comment: Answer "C" should be "5". Answer "D" should be "2".

NRC Resolution: Agree with facility comment. Answer key changed due to typos and transposed numbers.

22. Question 8.13

Facility Comment: D is a correct answer as well as A.

NRC Resolution: Agree with facility comment as per TS 3.8.1.1. A and D are acceptable answers.

b. RO Exam

1. Question 1.03

Facility Comment: Same as SRO 5.03.

NRC Resolution: Same as SRO 5.03.

2. Question 1.04

NRC Change: Same as SRO 5.04.

3. Question 1.07

NRC Change: Same as SRO 5.07.

4. Question 2.04

Facility Comment: Same as SRO 6.02.

NRC Resolution: Same as SRO 6.02.

5. Question 2.26

Facility Comment: Same as SRO 6.11.

NRC Resolution: Same as SRO 6.11.

6. Question 3.04

Facility Comment: Answer B correct for both units. Answer D also correct for Unit 2. Question not clear on which unit it is asking for.

NRC Resolution: Answers B and D are accepted. Facility comment verified by Unit 1 and 2 System Description.

7. Question 3.06

Facility Comment: Very similar to question 2.25, possible double jeopardy.

NRC Resolution: Different testing objectives; therefore, no double jeopardy.

2.25 was testing for RRS differences between Units 1 and 2.

3.06 was testing for pressurizer input.

8. Question 3.13

Facility Comment: On Unit 1 wide range detectors, there are four detectors, but two have two fission tubes and two have four fission tubes.

NRC Resolution: Answer not changed. Stands as is, as per Systems Description 4.

9. Question 3.14

Facility Comment: Same as SRO 6.18.

NRC Resolution: Same as SRO 6.18.

10. Question 3.16

Facility Comment: Now triple jeopardy question between questions 2.25, 3.06 and 3.16.

NRC Resolution: Disagree. Asking for knowledge of three distinct facts concerning the RRS system. Does not constitute triple jeopardy.

11. Question 4.06

    Facility Comment: Same as SRO 7.06.

    NRC Resolution: Same as SRO 7.06.

12. Question 4.09

    Facility Comment: Same as SRO 7.09.

    NRC Resolution: Same as SRO 7.09.

13. Question 4.11.d

    Facility Comment: Same as SRO 7.11.d.

    NRC Resolution: Same as SRO 7.11.d.

14. Question 4.12

    Facility Comment: Same as SRO 7.12.

    NRC Resolution: Same as SRO 7.12.

15. Question 4.14

    Facility Comment: Same as SRO 7.14.

    NRC Resolution: Same as SRO 7.14.

16. Question 4.17

    Facility Comment: Due to the formatting of the question being different from the way the procedure is accomplished and the fact that five of the answer key answers are incorporated in the one constant term in the actual calorimetric, we feel that this question should be deleted.

    NRC Resolution: Step 8.2 on page 3 of OP1-3200020 lists the simplified equation. In addition to Q core, it contains four heat input terms and four heat output terms and is not different in formatting from the question. No change to question or answer.

4. Candidates Comments for Regrade Request

a. SRO Exam

1. Question 5.11a

Candidate Comment: The operator unintentionally overfeeding a steam generator would not change the ECP.

NRC Resolution: This would change the ECP and the answer remains the same.

2. Question 5.13

Candidate Comment: The answer should be A and not B.

NRC Resolution: Recalculation revealed that answer A is the correct answer; therefore, answer key changed to answer A.

3. Question 6.01

Candidate Comment: Answer A is correct and answer C is incorrect....(references provided)".

NRC Resolution: References (FSAR, Chap. 8, EOP1/2-0030140) reveal that there is no correct answer to this question as stated. Question is deleted.

4. Question 6.09

Candidate Comment: All of the answers are a function of the Steam Bypass Control System.

NRC Resolution: Answer A was worded incorrectly. The SBCS is used to manually control RCS temperature. This is done via a controller that automatically controls steam header pressure. Question deleted due to inappropriate wording.

5. Question 6.13

Candidate Comment: Answer D is also a correct answer.

NRC Resolution: Distractor D was intended to be incorrect due to the "...two-dimensional axial flux mapping..." instead of three dimensional. Concept tested for was inappropriate due to wording of question. Either answer C or D was accepted.

6. Question 6.28

Candidate Comment: Answer A as stated, should be the incorrect answer, not C as the exam key states.

NRC Resolution: The question asked which statement was INCORRECT. References provided (S.L. 166, S.L. 102, Off-Normal Procedure 1-1110037) reveal all choices are correct. Question was deleted.

7. Question 7.12d

Candidate Comment: Answer should be both units.

NRC Resolution: Answer key changed to both units. Procedures reflect closing recirculation valves on both units.

b. RO Exam

1. Question 1.11a

Candidate Comment: Same as SRO 5.11a

NRC Resolution: Same as SRO 5.11a

2. Question 1.1.9

Candidate Comment: Answer D is correct in theory but not in practical applications. Answer A is also correct.

NRC Resolution: References supplied revealed that normal practice at St. Lucie is to start centrifugal pumps with discharge valves throttled slightly open (Procedures OP-2-0310020-CCW, OP-2-0640020-ICW). This allows a controlled filling and pressurization of a system. Answer key changed to reflect both answers.

3. Question 3.08

Candidate Comment: Same as SRO 6.13

NRC Resolution: Same as SRO 6.13

4. Question 3.25

Candidate Comment: Answer I should be accepted along with answer F.

NRC Resolution: Answer F - 195°F was based on training information. According to the reference provided by the candidate, "Plant Annunciator Summary," the setpoint is 200°F. We do not consider answer I - 225°F to be within an acceptable band of tolerance. No change to answer key.

5. Question 4.03

Candidate Comment: Answer A should be accepted in addition to answer D.

Also, asking subsequent operator actions is invalid.

NRC Resolution: Distractor A clearly states an action that should not be performed whereas the procedure stated that the action should be performed if necessary.

Knowledge of conceptual actions of Emergency Procedures is required regardless if they are immediate or subsequent. We believe the reducing the number of operating Reactor Coolant Pumps, following a tube rupture event, falls into this category.

6. Question 4.16

Candidate Comment: None of the choices given are correct. Question should be deleted.

NRC Response: The Off-Normal Procedure, OP No. 1-0620030, was revised subsequent to the submittal of material to the NRC for preparation of these examinations. Question was deleted since there is no correct answer.

5. Exit Meeting

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

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

MASTER

Enclosure 3

U. S. NUCLEAR REGULATORY COMMISSION

SENIOR REACTOR OPERATOR LICENSE EXAMINATION

Facility: St. Lucie
Reactor Type: PWR-CE
Date Administered: March 5, 1985
Examiners: Art Johnson/Bruce Wilson
Applicant: _____

INSTRUCTIONS TO APPLICANT:

Use separate paper for the answers. Write answers on one side only. Staple question sheets 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	Total	Score	Value		Category
~~30~~ 25	~~30~~ 25			5.	Theory of Nuclear Power Plant Operation, Fluids and Thermodynamics
~~30~~ ~~29~~ 26	~~30~~ ~~29~~ 26			6.	Plant Systems: Design, Control & Instrumentation
~~30~~ 29.5	30 29.5			7.	Procedures-Normal, Abnormal, Emergency Radiological Control
30	30			8.	Administrative Procedures, Conditions and Limitations
~~120~~ ~~113.5~~ 110.5	~~120~~ ~~113.5~~ 110.5				TOTALS

Final Grade _____%

All work done on this exam is my own, I have neither given or received aid.

_____
Applicant Signature

5.0 THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS AND THERMODYNAMICS

The following statements apply to Questions 5.01, 5.02, 5.03, 5.04 and 5.05.

The St. Lucie Unit-1 power plant has been operating at steady state 80% of full power for 10 days. All control rods are fully withdrawn (ARO). The fuel burnup status is that the core has reached 6000 EFPH on cycle-6. Use any of the provided figures and tables.

5.01 What is the expected value for the ΔT across the core? Choose the most <u>CORRECT</u> answer from those listed below. (1.0)

(a) 50°F
(b) 46°F
(c) 37°F
(d) 32°F

5.02 On your next shift, you observe that T_c is now higher than the previous (programmed) T_c by 2°F, the reactor coolant flowrate has not changed, the turbine-generator output power has not changed and the power plant is stable; indicate how each of the following parameters have changed (increased, decreased, no change). (2.0)

1. T_h
2. steam flowrate
3. steam temperature
4. steam pressure

5.03 Which one of the following correctly describes the response of core ΔT if the RCS coolant flow rate is reduced while the steam system is controlled to maintain 80% electrical output? (1.0)

a. ΔT will remain the same since the turbine/generator output power has not changed.

b. ΔT will remain the same but nuclear power will increase to provide the same megawatt thermal output.

c. ΔT will increase but nuclear power remains the same to provide the same megawatt thermal output.

d. ΔT will increase and nuclear power must increase to provide more steam flow to the turbine.

5.04 If the control rods are to be inserted while in the manual-sequential (MS) mode until Bank 7 is at 70 inches, and if the boron concentration is to be adjusted to maintain the present power level, calculate the new concentration of boron required for steady operation. Neglect any effect from changes in the Xenon or Samarium concentrations. (2.0)

5.05 How would the movement of rods (Bank 7 from ARO to 70 inches) affect the axial shape index. Explain if ASI becomes more positive or more negative. (1.0)

5.06 If the pressure in the pressurizer is 2250 psia, T_{HOT} = 600°F and T_{COLD} = 550°F, which of the following statements is CORRECT (1.0)

a. Pressurizer temperature = 653°F, RCS is 103°F subcooled
b. Pressurizer temperature = 653°, RCS is 53 °F subcooled
e. Pressurizer temperature = 635°, RCS is 35 °F subcooled
d. Pressurizer temperature = 635°F, RCS is 85 °F subcooled

5.07 Unit-1 is operating at 80% of full power with all-rods-out (ARO) and all parameters equal to their respective programmed values. The boron concentration is 500 ppm. The plant is to be taken to 100% of full power. What is the amount of reactivity that must be added to the core? Answer by choosing the most CORRECT answer from those listed below.

(a) 850 pcm
(b) 700 pcm
(c) 1210 pcm
(d) 580 pcm

(DELETED)

~~(1.0)~~

5.08 Figure 5.08 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 is neutron energy, Y is microscopic capture cross section.
(c) X is atom density of U-238, Y is neutron energy.
(d) X is microscopic capture cross section, Y is atom density of U-238.

5.09 Over reactor-core life, the Doppler Coefficient is most affected by what two (2) parameters? Answer by choosing the CORRECT response from those listed below. (1.0)

(a) Lower boron concentration and Pu-239 production
(b) Pu-240 production and increased heat transfer between fuel and cladding
(c) U-238 depletion and lower β_{eff}
(d) U-235 depletion and lower boron concentration

5.10 Gases that are in a solution in the reactor tend to come out of solution in the Pressurizer. Give two (2) reasons for this phenomena. (1.5)

5.11 The reactor is to be taken critical after having been shut down due to a reactor trip from 100% full power. The estimated critical position (ECP) for the rods has been calculated. Consider each of the following situations separately and answer, "Will be actual ECP be HIGHER, the SAME, or LOWER than the calculated ECP?"

a. The operator unintentionally over-feeds a steam generator. (0.5)

b. The actual boron concentration is lower than that used in the calculation for the ECP. (0.5)

c. Startup was delayed by four (4) hours beyond the time used in the calculation for the ECP. A shutdown time of sixteen (16) hours was used in the calculations. (0.5)

d. The steam by-pass/dump pressure set point is reduced 50 psi. (0.5)

5.12 Answer True or False for each of the statements below, regarding poisons in the core.

(a) The addition of soluble poison (boron) increases the flux peak-to-average ratio. (0.5)

(b) An increase in the amount of fission product poisons in the core will cause a more negative moderator temperature coefficient. (0.5)

(c) When soluble poison is added to the core, the thermal utilization factor will decrease, even though the soluble poison worth decreases. (in absolute valve) (0.5)

5.13 The data below was taken during a core fuel loading. Choose the predicted number of assemblies to obtain critical conditions from the choices below, after 15 assemblies have been loaded (Assume equal rod worths). (1.0)

Number of assemblies loaded	Neutron count rate (CPS)
10	75
15	105

(a) 28
(b) 30
(c) 33
(d) 35

5.14 After operating at 85% power for 80 hours, the reactor is shutdown. Which one of the statements below regarding Xe-135 concentration is CORRECT? (1.0)

(a) A larger dip and a faster recovery to equilibrium will occur, if you startup 5 hours after shutdown than if you startup 15 hours after shutdown.

(b) A smaller dip and slower recovery to equilibrium will occur if you startup 5 hours after shutdown than if you startup 15 hours after shutdown.

(c) A larger dip and a slower recovery to equilibrium will occur if you startup 5 hours after shutdown than if you startup 15 hours after shutdown.

(d) A smaller dip and a faster recovery to equilibrium will occur if you startup 5 hours after shutdown than if you startup 15 hours after shutdown.

5.15 Which statement below regarding critical heat flux is INCORRECT? (Assume no other parameter changes than those used in the responses) (1.0)

(a) Critical Heat Flux increases if reactor coolant flow rate increases.

(b) Critical Heat Flux decreases as reactor coolant pressure increases.

(c) Critical Heat Flux decreases as reactor coolant temperature increases.

(d) Critical Heat Flux decreases as reactor coolant subcooling decreases.

5.16 Which factor below will Increase fuel centerline temperature, assuming Tavg is maintained constant? (1.0)

(a) CLAD Creep
(b) Fuel densification
(c) Fission gas formation
(d) Pressurizing fuel rod with Helium

5.17 Which statement below regarding steam cycle thermodynamic principles is INCORRECT? (1.0)

(a) The entropy of steam decreases as it passes through a turbine.

(b) The specific enthalpy of feedwater is dependent upon its pressure.

(c) The enthalpy of the steam entering a turbine cannot be measured, only the change in enthalpy can be determined.

(d) Use of MSR's often result in decreased steam cycle efficiency though they increase overall reactor plant efficiency.

5.18 A variable speed centrifugal pump is rotating at 400 RPM, with a 200 GPM flow rate, at a discharge head of 30 psi drawing 60 kw of power. Pump speed is increased to 800 RPM. Which set of data below represents the new flow, discharge head and power requirements of the pump? (1.0)

(a) 400 gpm, 240 psi, 240 kw
(b) 800 gpm, 240 psi, 120 kw
(c) 400 gpm, 120 psi, 480 kw
(d) 600 gpm, 60 psi, 240 kw

5.19 Which parameter measurement below is evidence by itself, of a loss of natural circulation? ~~(1.0)~~

(a) Steam pressure decreasing with Tavg. (DELETED)
(b) Th steady.
(c) Steam Generator level increasing.
(d) Tc dropping slowly.

5.20 State whether tensile stresses are maximum on the outer or inner wall of the reactor pressure vessel for each of the conditions below. ~~(2.0)~~ (1.5)

(a) Pressure stress.
~~(b) Heat stress due to temperature differential.~~
(c) Cooldown stress due to temperature differential.
(d) Composite stress during cooldown.

5.21 Besides excessive heat generation in the core, low flow situations can cause DNB, leading to a condition called dryout. Which sequence below represents the stages of flow in a coolant channel approaching dryout? ~~(1.0)~~

(a) bubbly flow, sub-cooled nucleate boiling, annular flow, slug flow.

(b) sub-cooled nucleate boiling, bubbly flow, annular flow, slug flow.

(c) sub-cooled nucleate boiling, bubbly flow, slug flow, annular flow.

(d) sub-cooled nucleate boiling, annular flow, bubbly flow, slug flow.

(DELETED)

5.22 Match the reactor performance terms in column A with the approprite definition in Column B. ~~(1.5)~~

Column A	Column B
(a) Peaking Factor	(1) $\frac{\text{maximum local power}}{\text{average power}}$
(b) Nuclear Factor	(2) $\frac{\text{maximum heat generation rate}}{\text{average heat generation rate}}$
(c) Nuclear Peaking Factor	(3) $\frac{\text{local heat generation rate}}{\text{average heat generation rate}}$
	(4) $\frac{\text{local power}}{\text{average power}}$
	(5) $\frac{\text{maximum heat generation rate}}{\text{local heat generation rate}}$

(DELETED)

5.23 Which statement below regarding control rod worth is INCORRECT? (1.0)

(a) Anti-shadowing increases individual control rod worth.
(b) Overall control rod worth is greater at EOL than at BOL.
(c) As temperature decreases, so does control rod worth.
(d) Differential rod worth increases as neutron competition increases.

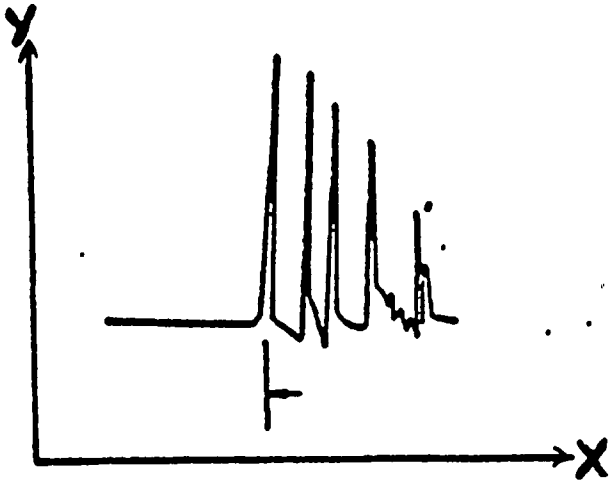
5.24 Indicate whether the specific component from the six-factor formula will Increase, Decrease or Remain The Same for the core changes given below. (1.5)

(a) "Reproduction Factor" as enrichment is increased.

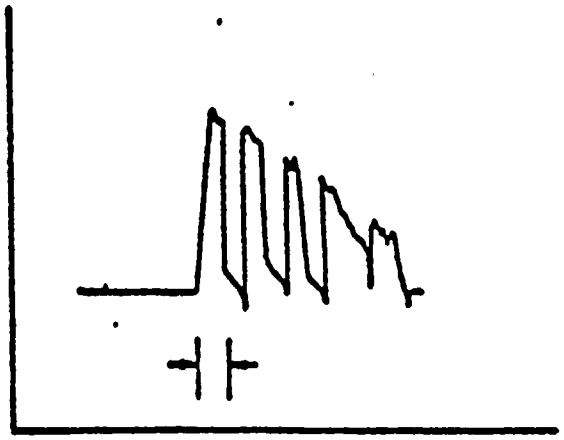
(b) "Resonance Escape Probability" as Moderator-to-Fuel Ratio Decreases.

(c) "Fast Fission Factor" at EOL compared to BOL

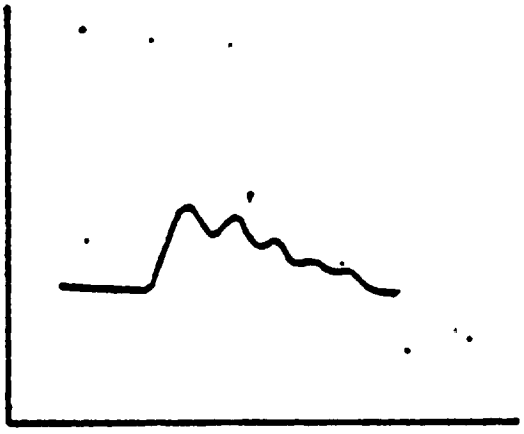
FIGURE 5.08



(A) RESONANCE REGION AT LOW ABSORBER TEMPERATURE



(B) RESONANCE REGION WITH INCREASED ABSORBER TEMPERATURE. (SMALL DOPPLER BROADENING)



(C) RESONANCE REGION WITH LARGE DOPPLER EFFECT

6.0 PLANT SYSTEM DESIGN, CONTROL AND INSTRUMENTATION

6.01 Which statement below accurately describes a characteristic of the D-C Power Distribution System? (DELETED) ~~(1.0)~~

(a) Unit 1 has four battery buses while Unit 2 has six battery buses.

(b) There are only three battery chargers that can be utilized for DC power at Unit 1.

(c) The battery chargers for Unit 2 can be picked up by the emergency diesel generators in 13 seconds on a loss of off-site power, whereas the chargers for Unit 1 take 40 seconds to be picked up by the diesels.

(d) A mechanical interlock in the DC power switchgear allows the batteries to be connected to their associated DC bus after the load bank breaker is closed.

6.02 Select the <u>INCORRECT</u> statement concerning the Instrument Air System. (1.0)

(a) On loss of instrument air, the backup air compressor will start at approximately 85 psig.

(b) At about 80 psig decreasing, the cross-connect capability from Unit 1 to Unit 2 is lost.

(c) If the backup compressor automatically starts, it must be manually stopped when air pressure is restored.

(d) Following a blackout, the air compressors must be locally reset on both units before being restarted.

6.03 Which one of the following statements regarding the 120 Volt instrument and vital AC systems is <u>TRUE</u>? (1.0)

(a) The normal source of 120 VAC vital is from 480 VAC MCC 1AB via step down and regulating SOLA transformers to the static switch and transfer switch to vital AC panel No. 1A.

(b) Unit 1 has 2 vital AC buses, while Unit 2 has only 1 vital AC bus.

(c) Both Units 1 and 2 normally utilize two 125 V DC buses to supply power to static inverters that feed eight 120 VAC instrument buses.

(d) The maintenance bypass transformers for providing alternate power to the 120 VAC instrument buses actually consist of two transformers, one to lower the voltage from 480 VAC to 120 VAC and one to stabilize and regulate the voltage.

6.04 Which one of the following is an INCORRECT statement regarding the Main Steam System? (1.0)

(a) Both Unit 1 and Unit 2 have two manual/electrical atmospheric dump valves which allow removal of core decay heat equivalent to 8% power.

(b) Only Unit 1 has a main steam check valve to prevent backflow from the other steam generator.

(c) The Main Steam Isolation Valves (MSIV) fail open on loss of electric power to the air solenoids but fail shut on loss of air supply.

(d) Sixteen safety valves for overpressure protection are associated with each unit's Main Steam System.

6.05 Which one of the following is a CORRECT statement concerning the Component Cooling Water (CCW) system differences between Units 1 and 2? (1.0)

(a) A low level in the CCW System surge tank will isolate the nonessential header at Unit 1, while this is not the case at Unit 2.

(b) The fuel-pool heat exchanger is supplied from A or B header at Unit 2. It is supplied by the non-essential header at Unit 1.

(c) The A and B headers at Unit 1 supply CCW to the Control-Room air conditioners. At Unit 2, the Control-Room air conditions are air cooled.

(d) The instrument air compressor (inside containment) at Unit 1 is supplied with CCW from the non-essential header. At Unit 2, it is supplied with CCW from the essential header.

6.06 Which one of the following is an INCORRECT statement concerning the Chemical Volume Control System differences between Units 1 and 2? (1.0)

(a) RCP seal water bleedoff to the VCT has two solenoid operated isolation valves on Unit 2. Unit 1 has one air operated isolation valve and one solenoid operated isolation valve.

(b) Unit 2 has an additional letdown isolation valve - air operated valve V-2522 - located outside the containment upstream of the letdown control valves.

(c) Unit 2 has an additional charging isolation valve - air operated valve V-2523 - located outside the containment down stream of the charging flow element.

(d) Unit 1 combined boric acid discharge valve-V-2161 is an air operated valve with a control switch on RTGB 105. On Unit 2 V-2161 is a manual valve.

6.07 Which one of the following is an INCORRECT statement concerning the purposes of the Fuel Pool Cooling and Purification System for Unit 1? (1.0)

(a) Maintain the water level a minimum of five feet above the top of the fuel during fuel handling and storage operations.

(b) Maintain purity and optical clarity of the fuel pool water.

(c) Maintain purity of the water in the refueling cavity and in the refueling water tank.

(d) Remove decay heat from the spent fuel and maintain pool water temperature less than 150°F.

6.08 The High Pressure Safety Injection (HPSI) System at Unit 1 is properly setup in Normal System Alignment (is in standby and lined up for emergency operation). Choose the one CORRECT statement. (1.0)

(a) Eight HP safety injection valves, HCV3626, HCV3627, HCV3636, HCV3637, HCV3646, HCV3647 are open.

(b) The RWT outlet valves (MV071A and B) are open.

(c) The containment sump outlet valves (MV072A and B) are open.

(d) HPSI discharge valves (HCV3653, HCV3654, HCV3655 and HCV3656) are locked open.

6.09 Which one of the following is NOT a function of the steam bypass control system (SBCS)? (DELETED) ~~(1.0)~~

(a) It provides a method of automatically controlling reactor coolant temperatures during plant startup.

(b) It prevents opening the safety valves and effects a smooth transition to hot standby conditions following a unit trip.

(c) It provides a method of maintaining steam generator pressure during hot standby.

(d) It provide a method for decay heat removal during cooldown.

6.10 Which one of the following is an INCORRECT statement concerning the inputs into the Reactor Regulating System as it applies to Unit 2 versus Unit 1? (1.0)

(a) Each RRS is supplied with two cold leg temperature signals, one for each reactor coolant loop.

(b) Each RRS is supplied with two hot leg temperature signals, one for each reactor coolant loop.

(c) Turbine power is transmitted to the RRS in the form of a turbine first stage pressure signal.

(d) Each RRS cabinet contains a power range control channel from an axially split out-of-core detector.

6.11 Which one of the following is an INCORRECT statement concerning normal operation of the Unit 1 Main Power Distribution System? ~~(1.0)~~

(a) If the 1B1 Station Service Transformer is out is service, then the 480 V 1A1 bus can be connected to the 480 V 1A2 bus such that the 1A1 Station Service Transformer feeds all of the "normal" 480 V loads.

(b) The turbine area 480 V MCC 1C can be fed from either the 480 V 1A1 or 1A2 buses.

(c) The 480 V 1A2 can be fed from either 480 V bus 1A1 or 1B1 but is normally aligned with 1B1.

(d) Both Emergency Diesel Generators will be operable with their output breakers on the 1A3 and 1B3 4.16 KV buses racked-in, but in the open position for standby service.

(DELETED)

6.12 Which one of the following is NOT a specific input for the reactor regulating system? (1.0)

(a) Cold leg temperature from two RTDs per loop for Unit 1
(b) Turbine first stage pressure
(c) Pressurizer level
(d) Reactor power from an out-of-core detector

6.13 Which one of the following best describes Unit 2 incore instrumentation? (1.0)

(a) One of the main purposes is to provide an accurate source-range neutron detection system during reactor startups following extended shutdowns.

(b) There are 80 fixed detector assemblies and two moveable detectors.

(c) The fixed and moveable detectors can aid in calibration of the excore detectors by providing power distribution information.

(d) In each detector assembly, there are four self-powered rhodium detectors which measure the neutron flux distribution and provide a two-dimensional axial flux mapping of the core.

6.14 The Engineered Safety Feature Actiuation System (ESFAS) has five (5) functions which are initiated during various plant conditions. Which one of the following is a correct actuation signal for the indicated function and unit? (1.0)

(a) Unit 2 SIAS - Pressurizer Pressure $\leq$1600 psia or containment pressure $\geq$5 psig.

(b) Unit 1 CSAS - SIAS and Containment Pressure $\geq$10 psig.

(c) Unit 2 MSIS - S/G pressure $\leq$500 psia or containment pressure $\geq$5 psig.

(d) Unit 1 RAS - RWT level $\leq$6 ft.

6.15 Which statement below about the Unit 2 auxiliary feedwater actuation signals (AFAS) is correct? (1.0)

(a) The AFAS logic employs a two out of four actuation sequence of system components, despite having only three channels of initiating signals, through the use of a manually controlled fourth channel.

(b) The parameters monitored by the AFAS initiation circuits are feedwater flow 1 and 2, steam geneator level 2A and 2B and steam generator pressure 2A and 2B.

(c) The cycling relays control the auxiliary feedwater pumps and the main feedwater isolation valves and will automatically reset when a steam generator is refilled.

(d) If loss of inverter output power to two AFAS channels occur, the battery fail bypass actuates and bypasses one of the affected channels creating a one-out-of-two trip logic.

6.16 Which statement below, regarding the circulating water system is INCORRECT? (1.0)

(a) When a circulating pump is started, its corresponding discharge valve automatically opens to 30% and then fully opens 15 minutes later if the pump is still running.

(b) In order to start circ water pump 1A1, the discharge valve for circ water pump 2A2 must either be shut or fully open with circ pump 2A2 running.

(c) If a circ water pump is started with its discharge tunnel already being supplied by the other common circ pump, then it takes only five minutes for the second circ pump's discharge valve to open.

(d) If lubricating water flow to an idle circulating pump is less than 8 gpm, the pump cannot be started.

6.17 Which one of the following is NOT directly affected by the Nuclear Instrumentation Systems (NIS) 15% bistable? (1.0)

(a) High startup trip rate circuitry
(b) Local power density trip circuity
(c) Reactor trip on loss of turbine circuitry
(d) Thermal margin/low pressure trip circuitry

6.18 Select the CORRECT statement concerning the Diesel Generators. (1.0)

(a) Under an automatic start signal only an overspeed trip, "86" generator fault or emergency stop pushbuttons will shutdown the unit.

(b) The "Emergency Stop" pushbutton on the engine control panel door, the "Emergency Stop" pushbutton on either of the engine terminal box doors or the "86" (generator lockout) switch can be used to shutdown the unit in an emergency.

(c) The Normal Stop can be initiated remotely or locally when the unit is running without an automatic signal.

(d) If after 10 seconds of air start motor operation, the engine has not reached 600 RPM, the "fail-to-start" circuit will be energized and the engine will shutdown/lockout.

6.19 Component Cooling Pumps 1A and 1B have a control room START-AUTO-STOP switch and two local switches on the respective switchgear; ISOLATE-NORMAL and CLOSE-TRIP, and local pump motor STOP-START pushbuttons. Select the CORRECT statement concerning these four switches. (1.0)

(a) With the ISOLATE-NORMAL switch in NORMAL, both the control room switch and the switchgear CLOSE-TRIP switch can be used to start or stop the pump.

(b) With the ISOLATE-NORMAL switch in ISOLATE, the control room switch, automatic actuation features and the switchgear mounted CLOSE-TRIP switches are rendered inactive.

(c) The automatic actuation features on the Pumps will function with the ISOLATE-NORMAL switch in either position.

(d) With the ISOLATE-NORMAL switch in NORMAL, the local switchgear CLOSE-TRIP switch is rendered inactive.

6.20 Select the INCORRECT statement concerning the input signals to the Steam Bypass Control System (SBCS). (1.0)

(a) The SBCS receives steam header pressure signals from two independent transducers.

(b) The SBCS monitors the four undervoltage relays (of the RPS) whose contacts close on a reactor trip.

(c) The SBCS receives the Tavg signal from the RRS.

(d) The SBCS receives the steam flow - feed flow mismatch signal from the feedwater regulating system.

6.21 Which statement below is CORRECT for the normal operation of the bypass feedwater regulating system below 15% power. (1.0)

(a) The input signal is steam flow and the final control element is the feedwater bypass valve.

(b) The input signal is steam generator level from the same transmitter that is used by the 3-element control system.

(c) A proportional and reset controller is used to control feedwater flow to maintain S/G level equal to a setpoint.

(d) The input signal is steam generator level and the feedwater regulating control valve and the feedwater bypass valves are the final control elements.

6.22 Which statement below, regarding the engineered safety features actuation system (ESFAS) is INCORRECT? (1.0)

(a) An SIAS must occur in order to energize the relays allowing CSAS to actuate, even if containment pressure exceeds its actuation setpoint.

(b) The MSIS can be initiated by two out of four low pressure signals from either set of steam generator pressure transmitters.

(c) The SIAS block to permit shutdown depressurization is manually inserted once the "block permissive" annunciator is actuated, as pressure drops, and manually unblocked when pressure rises above the "low pressurizer pressure" setpoint.

(d) A block for both the SIAS and MSIS functions can only be achieved when three out of four channels have reached a permissible valve, actuating the appropriate block annunciator.

6.23 Which of the following is INCORRECT with respect to the Digital Electro-Hydraulic (DEH) turbine control system? (1.0)

(a) The low bearing oil pressure trip actuates at 5-7 psig.

(b) The overspeed trip mechanism will dump auto stop oil at a turbine speed of 1908 rpm.

(c) Primary lockout and backup lockout will cause the solenoid trip to actuate and dump auto stop oil.

(d) The low vacuum trip will open the trip valve at 2-3 psig when "latched" and at 18-22 in. hg when "unlatched."

6.24 Indicate whether the following statements concerning the Containment Spray System apply to Unit 1, Unit 2, or BOTH.

(a) When the RWT decreases to its low level setpoint, a RAS signal is generated which shifts the containment spray pumps suction from RWT to the containment sump. (0.5)

(b) The containment spray system can be lined up to supply the total or part of the suction to the HPSI pumps. (0.5)

(c) The containment spray system utilizes the hydrazine in the spray as an Iodine removal method. (0.5)

(d) The containment spray pumps are provided cooling water by the CCW system. (0.5)

6.25 Which one of the following statements concerning the LPSI/Shutdown Cooling System is CORRECT? (1.0)

(a) The hot leg suction valves to the LPSI pumps automatically close at an increasing RCS pressure of 500 psig.

(b) The LPSI pumps can be used in fill and makeup to the SIT's with RCS pressure less than 1500 psig.

(c) When using the system for shutdown cooling, purification of the RCS coolant using the CVCS demineralizers is not available.

(d) The LPSI pumps start automatically on SIAS and are stopped automatically when RCS temperature reaches 325 degrees.

6.26 Indicate whether the following statements concerning the Liquid Waste Management System are TRUE or FALSE.

(a) Fission gases are removed from the water in the flash tank by using a cation demineralizer in the supply line to the flash tank. (0.5)

(b) When the liquid in the reactor drain tank (RDT) reaches a high level, the RDT pumps automatically start and transfer the RDT contents to the flash tank. (0.5)

(c) The liquid in the holdup tanks can be used as a flushing water during sluicing operations for the spent resin tank. (0.5)

(d) The use of a nitrogen over-pressure in the RDT, flash tank, and holdup tanks prevent the formation of explosive mixtures of hydrogen in these tanks. (0.5)

6.27 Which one of the following signals would prevent CEA withdrawal in any mode? (1.0)

(a) High SUR.

(b) Tavg 7.0 degrees greater than Tref.

(c) Any CEA is dropped, as sensed by the nuclear instrumentation channel.

(d) RCS pressure less than 2000 psig.

6.28 Which one of the following automatic control functions for the given radiation monitor on Unit 1 is <u>INCORRECT</u>? (DELETED) ~~(1.0)~~

(a) S/G Blowdown Monitor - closes blowdown FCV's and blowdown sample FCV's.

(b) Gaseous Discharge Monitor - closes discharge valve if release is in progress.

(c) Control Room Outside Air Intake Monitor - places control room in emergency recirculation using HEPA and charcoal filters.

(d) CCW Monitor - Swaps vent valve of CCW surge tank to chemical drain tank.

7.0 PROCEDURES: NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

7.01 While operating a 100% of full power, St. Lucie Unit 2 experiences a slow decrease in the condenser vacuum. List (8) things that could be checked to determine the cause of the decrease in the condenser vacuum. (2.0)

7.02 List the three (3) steps that must have been completed so that a system, that had been tagged-out for maintenance, can be considered to be "ready for service." (1.5)

7.03 Which one of the following is a <u>CORRECT</u> statement of a subsequent action in the Steam Generator Tube rupture procedure, EP 2-0120041? Assume the reactor is shutdown and SIAS is not received. (1.0)

a. If an SIAS has not been received, do not isolate letdown.
b. Ensure condenser air ejector vent is isolated.
c. Ensure Blowdown on affected S/G is aligned to Monitor Storage Tanks.
d. Stop one Reactor Coolant Pump in each loop.

7.04 In the Emergency Operating Procedure, 2-0120040, "Natural Circulation/Cooldown," there is a step during cooldown which states, When using auxiliary spray to decrease the Pressurizer pressure, maximize the use of letdown flow through the Regenerative Heat Exchanger, when available, ..." What is the reason for this instruction? (1.0)

7.05 List three (3) conditions for which an Inverse Count Rate Ratio (ICRR) shall be plotted during an approach to criticality at St. Lucie Unit 2. (1.5)

7.06 While operating at 100% of full power on Unit 2, an increase in Component Cooling Water (CCW) is observed on the indicators PLP-101 and PLP-102. This is followed by an indicated rise in the level of the CCW surge tank. Which of the following is <u>NOT</u> a potential source of the activity in the CCW system? (1.0)

a. Letdown heat exchanger
b. Sample heat exchangers
c. Shutdown cooling heat exchangers
d. Low Pressure safety injection Pumps

7.07 Complete the following statements concerning HPSI termination criteria as contained in the "HPSI-Off Normal Operation Procedure," OP1-0410030.

a. RCS is maintained _____ subcooled (0.5)

b. Pressurizer pressure and level is controllable with indicated level > _____% and stable. (0.5)

c. No indication of _____. (0.5)

d. S/G level is controllable with indicated wide range level > _____% and stable. (0.5)

e. _____ equipment is available and entry conditions can be established by RCS cooldown procedures. (0.5)

f. Permission is obtained from the _____. (0.5)

7.08 Which one of the following is NOT a symptom of condenser tube leak as contained in Off-Normal OP-1-0610030, "Secondary Chemistry - Off Normal"? (1.0)

a. Increase in cation conductivity in the condensate header
b. IA S/G specific conductivity increasing
c. Increase in hotwell chloride monitor
d. Hotwell quadrant cation conductivity increasing or alarming

7.09 Assume Unit 1 is operating at 100% power when a main feedwater pump trips. List the expected Automatic Actions and your Immediate Actions assuming the transient does not cause a reactor trip. (2.0)

7.10 Which one of the following is an INCORRECT immediate action in OP 1-2000030, "Loss of Reactor Cavity Cooling Fans or Reactor Support Fans?" (1.0)

a. If one cavity cooling fan or one support cooling fan has been lost, attempt to restart the failed fan to determine operability.

b. If both cavity cooling fans or both support cooling fans have been lost and one or both fans cannot be restarted immediately initiate a plant shutdown per OP 1-0030125, "Turbine Shutdown, Full Load to Zero Load."

c. If both cavity cooling fans or both support cooling fans have been lost and one or both cannot be restarted, notify Duty Call Supervisor and continue plant operation while carefully monitoring TR-25-1 and 2.

d. If one cavity cooling fan or one support cooling fan has been lost and is declared inoperable, notify the Duty Call Supervisor.

7.11 Answer the following questions TRUE or FALSE concerning the differences in Emergency Procedure Immediate Actions between Units 1 and 2.

a. Following a blackout, you must place reheater control system in manual, then close TCVs on Unit 1 but not Unit 2. (0.5)

b. On Control Room Inaccessibility, you must take the Remote Shutdown Room Keybox Master Key with you on Unit 2 but not Unit 1. (0.5)

c. On Total Loss of AC Power, the actions taken to isolate letdown flow on both units are identical. (0.5)

d. On Inadequate Core Cooling you are required to verify natural circulation on Unit 1 but not on Unit 2 (0.5)

7.12 For the following Immediate Actions for Emergency Boration, identify if the action is required for Unit 1, Unit 2 or both.

a. Place Makeup Mode Select Switch in Manual or Borate position (0.5)

b. Verify V-2525 (load control valve) is closed (0.5)

c. Start either boric acid pump (0.5)

d. Close V-2650 and V-2651 (BAMT Recirc's) (0.5)

e. Note: If VCT level is >5%, V-2501 will not remain closed in the AUTO position unless switch is held to CLOSE. (0.5)

7.13 OP 1-2200050, "Emergency Diesel Periodic Test," Synchronizes a diesel generator with its appropriate 4160V bus, then has the diesel assume some of the electric load on the bus. The operator must verify reactive load is picked up by the diesel. This is done by observing that the varmeter is _____. (1.0)

a. Reading slightly in the "Lead" direction
b. Reading substantially in the "Lead" direction
c. Reading slightly in the "Lag" direction
d. Reading substantially in the "Lag" direction

7.14 Which one of the following is NOT a requirement for increasing RCS pressure greater than 1750 psig on a Unit 2 reactor plant heatup from cold to hot standby? (1.0)

a. Two independent containment spray systems shall be operable with each spray system capable of taking suction from the RWT on a SIAS and automatically transferring suction to the containment sump on a RAS.

b. At least three safety injection tanks operable with each tank containing 74-94% borated water with a concentration between 1720-2100 ppm, having nitrogen cover pressure between 235-650 psig and its isolation valve open.

c. Two independent ECCS subsystems shall be operable consisting of at least one HPSI pump, one LPSI pump and one charging pump.

d. RCS dissolved oxygen concentration shall be <.1ppm.

7.15 Indicate whether the statements below regarding a reactor startup are TRUE or FALSE.

a. If criticality is not achieved by the +500 pcm of ECC value is reached, CEAs should be inserted to the calculated ECC position and start checking the ECC calculation. (0.5)

b. Reed switch position indicators and pulse counting position indication should agree within 4.5 inches on Unit 1 and 5 inches on Unit 2. (0.5)

c. The startup channel detectors on Unit 2 should be switched off at 1000 cps. (0.5)

d. After the CEA shutdown groups are withdrawn fully, then the regulating groups are sequentially withdrawn in the manual sequential mode, observing that the rod bottom lights clear when each regulating group reaches approximately 4 inches. (0.5)

e. Once the reactor is critical, reactor power must be stabilized at 5×10^{-4}% in order to record the actual critical conditions. (0.5)

7.16 Which one of the following statements is NOT correct during filling and venting of the RCS? (1.0)

a. Do not attempt to vent if the RCS temperature is above 200°F.

b. Do not allow RCS pressure to decrease below atmoshperic.

c. Do not operate the Control Element Drive Mechanisms (CEDMs) below 200 psig unless they have vented.

d. Do not operate a RCP until the RCS has been pressurized and major air pockets removed.

7.17 The Refueling Machine bridge drive has interlocks that make it inoperative in either direction. Which one of the following is NOT a correct interlock? (1.0)

a. The mast bumper is actuated.

b. The grapple is in or below the Upper Grapple Operate Zone.

c. The hoist is being operated.

d. The spreader is retracted.

7.18 If the Gaseous Discharge Monitor on Unit 1 is inoperable, a Gas Decay Tank can be released under certain conditions. Which one of the following is NOT a correct condition? (1.0)

a. Two independent samples are obtained on each gas decay tank.

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge valve lineup (one performs, one verifies).

c. The monitor shall not be inoperable for a period exceeding 21 days. After 21 days of an inoperable condition, suspend release of radioactive material via this pathway.

d. Operations Department shall terminate any batch release immediately if a High Alarm conditions is received on any Plant Vent Channel.

7.19 Which one of the following statements is NOT correct when making a controlled release of liquid from the Waste Monitor Tanks from Unit 1? (1.0)

a. If activity reaches the HI-RATE setpoint as indicated on the Release Permit, an alarm is activated in the Control Room and FCV-6627X trips closed.

b. Do not re-initiate a liquid release that has been terminated by a monitor alarm until authorized by the Shift Supervisor.

c. At least one circulating water pump should be in service during liquid releases, or the minimum number allowed on the Liquid Release Permit.

d. The Operator shall perform a release only after receipt of an approved Liquid Release Permit.

7.20 Which one of the following statement, is NOT correct for the operation of the CVCS system on Unit 2? (1.0)

a. The temperature of the reactor coolant downstream of the Letdown Heat Exchanger should be maintained greater than 140°F and less than 175°F.

b. The charging and letdown systems should be started and stopped simultaneously to minimize pressure and temperature transients in the Charging and Letdown System.

c. When in Modes 1, 2, 3 and 4, two Charging Pumps shall be operable.

d. To place the Borometer in service, open the Boronmenter Flow Stop valve, slowly open the Boronmeter Return Flow Isolation valve and adjust to maintain a flowrate of 8 gpm.

7.21 Which one of the following Immediate Automatic Actions, listed under Accidents Involving New or Spent Fuel for Unit 2, is NOT listed for Unit 1? (1.0)

a. For damage to new fuel - none.

b. If damage to spent fuel occurs inside Containment, a Containment Isolation Actuation Signal (CIAS) may occur.

c. Containment evacuation alarm may actuate.

d. If damage to spent fuel occurs in the Fuel Handling Building (FHB), a high radiation signal may alarm in the Control Room which will isolate the FHB and activate the Shied Building Ventilation System.

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS AND LIMITATIONS

8.01 Indicate whether the following statements are TRUE or FALSE with respect to Plant Work Orders (PWOs).

(a) If, in the opinion of the Nuclear Plant Supervisor or Assistant Nuclear Plant Supervisor, emergency work is required to restore equipment or systems to normal operating conditions; the work can be performed under these emergency conditions without a complete PWO package. (0.5)

(b) All modification, preventative and corrective maintenance not covered by Blanket Work Orders which is to be performed by Florida Power and Light personnel at the St. Lucie Plant shall be authorized through the Plant Work Order, Form 1784. (0.5)

(c) When a condition requiring modification or maintenance is known, it must be reported and documented by requesting that the Operations Supervisor initiate a PWO. (0.5)

(d) If an AO observes that a relief valve in the CVCS requires replacement or maintenance, he should report the situation by completing Section "A" of the PWO and by checking the "yes box" in Section "B" under "Rad Work Permit Required." (0.5)

8.02 A reactor operator has just completed his 8 hr shift in the Unit 1 Control Room. He had not been on duty the previous shift. He had left from his home for the St. Lucie Plant 1 hr before his shift was to start. He then spent 1/2 hr in shift-turnover duties and then spent 8 hrs on duty in the Control Room. During the 8 hrs in the Control Room, the reactor operator had been temporarily relieved of his primary duties about every hour. The power plant is operating at 100% of full power. If his replacement from the next shift fails to arrive, can he continue with the duties of a shift-RO without being in violation of the administrative limitations on overtime? (Specify the administrative criteria that you used in reaching your answer.) (2.0)

8.03 Classify the following conditions at St. Lucie Unit 1 according to the "Classification of Emergencies", Revision 14. Consider each part of the question (each event), as separate and unrelated to the other events. Classify each as Unusual Event, Alert, Site Area Emergency or General Emergency. (1.0)

a. power: 100%
all Ts (Tc, Th, Tave, Tsteam,...): normal
Pzr level: normal
Pzr pressure: normal
letdown iodine process monitor: alarms
chemistry analysis of primary coolant: 256 μCi/gm
electrical: normal

b. power: 100% (1.0)
all Ts: normal
Pzr level: -5% and decreasing
Pzr pressure: 2200 psia and decreasing
containment pressure: 1 psig
containment radiation monitors: 10^4 mR/hr
electrical: normal

c. power: 100% (1.0)
all Ts: normal
Pzr level: -2% and increasing
Pzr pressure: 2220 and decreasing
blowdown process monitors: increasing
condensate air ejector monitors: 5×10^3 μCi/cc
electrical: 6.9 kV and 4.16 kV buses are lost

8.04 Both Units 1 and 2 are operating at 100% of full power.

a. List the minimum shift crew composition for the two units combined as required by Tech-Specs. Indicate which unit each crew member is assigend. (2.0)

b. According to Tech-Specs, during the absence of the Shift Supervisor from a specific Control Room, an individual shall be designated to assume the Control Room command function. What qualifications and conditions pertain to the designation of this individual? (1.0)

8.05 Tech-Specs stipulate that an OPERATIONAL MODE (i.e., MODE) shall correspond to a combination of the core-reactivity condition, power level and average reactor-coolant temperature. Provide the definition of the MODES by completing the following table. Give the mode name and conditions for Modes 2 through 6 in the same format as below. (3.0)

OPERATING MODES

Operating Mode	Reactivity Condition, keff	% of Rated Thermal Power	Average Coolant Temperature
1. Power operation	$\geq$0.99	>5%	$\geq$325°F

8.06 Indicate whether the following statements are TRUE or FALSE. Temporary changes to procedures may be made as per Tech Specs, provided:

a. The intent of the original procedure is not altered. (0.5)

b. The change is approved by two (2) members of the plant management staff, at least one of whom holds a SRO License on the affected unit. (0.5)

c. The change is documented, reviewed by the FRG and approved by the Plant Manager within 21 days of implementation. (0.5)

8.07 List five (5) Logs that the NPS and/or the ANPS shall acknowledge reading on each shift with an entry in Check Sheet #1 of AP 0010125, "Schedule of Periodic Tests and Checks." (1.5)

8.08 For each of the items "a." through "f.", list the number corresponding to the description in the right-hand column which accurately describes the item. (2.0)

a. sil ver-zeolite cartridge	1. A designated facility for use in communicating with the news media
b. portable air sampler	2. An area around the plant with about a 10 mile radius for which detailed plans are made to protect people from radiation
c. Plume Exposure Pathway	3. Emergency Communication Systems
d. EPZ	4. A designated facility from which FPL emergency activities will be coordinated
e. EC	5. That area, for which emergency planning consideration of the plume exposure and ingestion pathways has been given in order to protect the public
f. EOF	6. The NPS when an event has been classified as an Alert or worse
	7. Used with the radiation sensor or in the plant stack to monitor noble gases
	8. Used with a portable detector to monitor airborne concentrations of radioiodine in the Control Room
	9. Used with portable equipment to determine radioisotopic content in the air in the Control Room

8.09 According to Unit 1 Tech Specs 3.7.1.5, the MSIVs are required to be operable in what modes? (Select One) (1.0)

a. 1, 2, 3, 4 only
b. 1, 2, 3 only
c. 1, 2 only
d. All modes

8.10 According to Unit 2 Tech Specs 3.7.1.6, the main feedwater isolation valves are required to be operable in what modes? (Select one) (1.0)

a. 1, 2, 3, 4 only
b. 1, 2, 3 only
c. 1, 2 only
d. All modes

8.11 Match the following conditions with the correct Tech Specs reporting requirement (labelled A, B, and C, below) (2.0)

_____ 1. Limiting safety system setting exceeded

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

_____ 3. Abnormal degradation discovered in the primary containment

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

A. Prompt notification
B. Thirty Day Written Reports
C. No Report Required

8.12 With the plant critical, the reactor operator reports to you that Tavg is 510 degrees F.

a. What does the Tech Specs require you to do? (Include time limit) (1.0)

b. What required action must you take if you cannot meet the time limit in "a" above? (Include time limit) (1.0)

8.13 Which one of the following main power distribution system failures does not meet the limiting condition for operation, during power operations for Unit 1? (1.0)

(a) One start up transformer may be out of service for one week provided the remaining AC sources are demonstrated operable within one hour of component failure and at least once every 8 hours thereafter.

(b) One emergency 480 Volt load center may be out of service 8 hours.

(c) One battery charger may be out of service indefinitely provided the two remaining chargers are operable.

(d) One diesel generator is out of service more than 72 hours provided the remaining diesel is tested daily, its associated engineering safety features are operable and the start up transformer is operable.

8.14 "When a clearance is released, partially or completely, the clearance that directs the change of state shall be independently verified." Under what two conditions can this independent verification be waived? (1.0)

8.15 Unit 2 is in Mode 1 with one Safety Injection Tank inoperable due to the discharge valve being closed. (Select one) (1.0)

a. Open the valve within one hour and be in at least hot standby within the next 6 hours

b. Open the valve within one hour or be in at least hot standby within the next 6 hours.

c. Open the valve immediately or be in at least hot standby within 1 hour.

d. Continue operating. (Three accumulators operable meet the requirements of Tech Specs.)

8.16 What is the basis for all MSIVs to be operable? (Select One) (1.0)

a. Ensure only one S/G will blow down in the event of a steam line rupture.

b. Minimize the negative reactivity effects associated with a steam line rupture cooldown.

c. Ensure that S/G transients from a steam rupture do not exceed the maximum allowable pressure limit.

d. Ensure we do not rely on the S/G safeties to relieve pressure that can normally be relieved to the steam system thru the MSIVs.

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 From the items listed below select the one which must be controlled by the Disconnected Lead and Temporary Jumper Log. (1.0)

a. Removal and replacement of a lead in accordance with an approved procedure.

b. Removal of a lead while troubleshooting the pressurizer level control instrument.

c. A blind flange used in the service water system, which is removed by the installation procedure.

d. Hand held jumpers used during an approved testing procedure.

MASTER

5.0 THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS AND THERMODYNAMICS ANSWERS

5.01 C. (1.0)

100% Full Power TH = 595°F
TC = 549°F

At 80% ΔT = (.8)(46) = 37°F

Reference: St. Lucie 1&2: "Power Plant Thermodynamics," pgs. 68, 74, 83

5.02 1. T_h has increased (+0.5)

2. steam flowrate has decreased (+0.5)

3. steam temperature has increased (+0.5)

4. steam pressure has increased (+0.5)

Reference: St. Lucie 1&2: "Power Plant Thermodynamics,"pp.68, 74, 83.

5.03 ~~D.~~ C (1.0)

If the flowrate is reduced, more heat will be added to the coolant as it passes through the core. This will raise the core ΔT. An increase in the temperatures of the core will cause the power produced in the core to try to decrease. However, if the electrical output is to remain the same, the secondary system will adjust and the increase in the core ΔT will remain to offset the decrease in the primary flowrate.

Reference: St. Lucie 1&2: "Power Plant Thermodynamics," pp. 68, 74, 83.

5.04 New boron concentration ≈~~494~~ 439 ppm.

Using Figure A.6

integral worth ARO = 8142 pcm
integral worth 70 in/Bank 7 = 7842 pcm

Hence, the reactivity change due to inserting the rods is 300 pcm (0.5).

Thus, the needed change in the boron concentration is

$$\frac{300}{9.8} = 31 \text{ ppm.} \qquad (+0.5)$$

Using Figure C.2, the initial (critical) boron concentration was ~~525~~ 470 ppm. (0.5)

Therefore, the answer is ~~525~~ 470 - 31 = ~~494~~ 439 ppm. (0.5)

Reference: St. Lucie Unit 1 Curves, Figure A.6, C.1, C.2

5.05 ASI becomes more positive since Bank 7 rods are driven into the core about halfway. The flux would be depressed in the top of the core and since ASI = $\frac{L-U}{L+U}$, it goes positive. (1.0)

Reference: TS Definition 1.23

5.06 b. (1.0)

Reference: CE Steam Tables

Sat. Temp for 2250 psia = 653°F
653°F - 600 = 53°F Subcooling

5.07 a. (DELETED) ~~(1.0)~~

Figure A.1, power defect at 80% of full power = -1500 pcm
power defect at 100% of full power = -2353 pcm.

Hence the reactivity effect due to temperature changes in going from 80% to 100% is 853 pcm.

Reference: St. Lucie 1&2: Unit 1, Plant Curves, Figures 3.1, A.2, A.3, A.4

5.08 b. (1.0)

Reference: St. Lucie 1&2: "Reactor Physics," pp 7.3-24 through 7.3-26

5.09 b. (1.0)

Reference: St. Lucie 1&2, "Reactor Theory" pps 50 (82J8)/d-22 and 23

5.10 1. The deaerating effect of the pressurizer sprays. (.75)

2. The solubility of gases decrease with increasing temperature (.75) and the temperature in the Pressurizer is higher than that of the coolant entering the Pressurizer.

<u>Reference(s)</u>

1. St. Lucie 1&2: Lesson Plans and System Descriptions, Lecture Outline and Study Guide #1, "Reactor Coolant Gas Vent System."

5.11 a. lower (0.5)
b. lower (0.5)

c. lower (0.5)
d. lower (0.5)

References: 1. St. Lucie 1&2: St. Lucie Training Documents, "Reactor Physics," Sections 7.5 and 7.7.

5.12 Answer (a) False (0.5)
(b) True (0.5)
(c) True (0.5)

References (a) NUS, Reactor Operation pp 7.3-4
(b) NUS, RO pp 9.2-3
(c) NUS, RO pp 9.4-1, 9.6-1

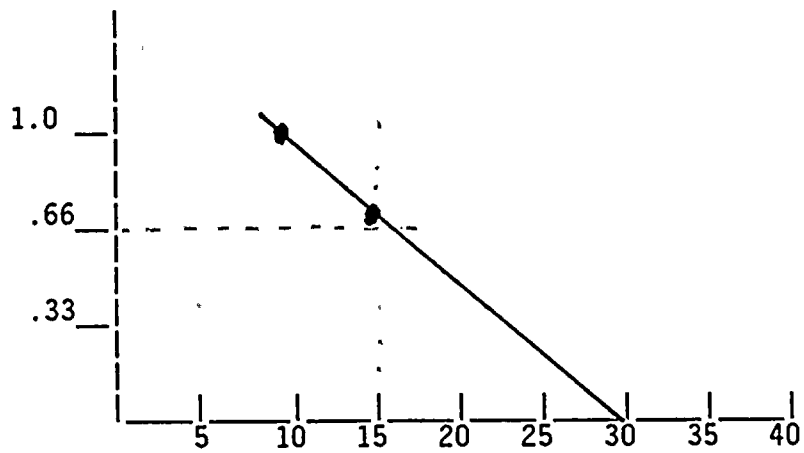
5.13 Answer ~~(b)~~ (1.0)
a

References

NUS, Reactor Operator, Section 12. 2

$\frac{1}{M} = 1-k = CR1/CR2$

$M = \frac{CR2}{CR1}$



5.14 Answer (d) (1.0)

Reference

NUS, RO, Section (10.3)

5.15 Answer - (b) (1.0)

Reference

Heat Xfer, Thermodynamics and Fluid Flow, General Physics, pp 226-7

5.16 Answer - (b) (1.0)

Reference

Heat Xfer, Therm, Fluid Flow - General Physics, pp 238-240

5.17 Answer: (a) (1.0) or (c)

Reference Heat Xfer, Thermo, pp 148, 35, 36, 143
Fluid Flow-General Physics

5.18 Answer: (c) (1.0)

Reference: Heat Xfer, Thermo, Fluid Flow - GP pp 322

5.19 Answer ~~(c) (1.0)~~ (DELETED)

Reference: Heat Xfer, Thermo, Fluid Flow-GP pp 356-357

5.20 Answer (0.5 each)

(a) Inner
~~(b) Outer~~ (DELETED)
(c) Inner
(d) Inner

Reference

NUS - Plant Performance, pp 10-1.8/9

5.21 Answer - ~~(c) (1.0)~~ (DELETED)

Reference NUS - Plant Performance, pp 8.2-2/3

5.22 Answers

~~(a) 2 (0.5)~~
~~(b) 4 (0.5)~~
~~(c) 1 (0.5)~~ (DELETED)

Reference

NUS - Plant Performance - 8.1-4, 10.2-4

5.23 Answer (d) (1.0)

Reference NUS - Reactor Operation pp. 9-4-1/2 , 9.5-1/2

5.24

(a) Increase (0.5)
(b) Decreases (0.5)
(c) Same (0.5)

Reference NUS, Reactor Operation pp 3.2-1, 3.4-2, 3.5-2

6.0 PLANT SYSTEM DESIGN, CONTROL AND INSTRUMENTATION - ANSWERS

6.01 ~~(c)~~ (DELETED) ~~(1.0)~~

Reference: DC Power System Lecture Notes, pages 1-6.

6.02 (d) or (b) (1.0)

Reference: Lecture Outline 85, page 5.

6.03 (d) (1.0)

Reference: Lesson Plan #33, pages 2-5

6.04 (a) (1.0)

Reference: Lesson Plan #61

6.05 (b) (1.0)

Reference: SD 9 and Lecture Outline 52 page 9

6.06 (a) (1.0)

Reference: SD-CVCS

6.07 (a) (1.0)

Reference: Lecture 57, page 1

6.08 (b) (1.0)

Reference: SD 45 page 2 of 12

6.09 (a) There are no automatic controls on plant startup (1.0)

Reference: Lecture Outline #95, pp1

6.10 (a) (1.0)

Reference: Lecture Outline 93, page 3 of 8

~~6.11 (c)~~ (DELETED) ~~(1.0)~~

Reference: SD 20, page 3-5

6.12 c - it uses PZR press, not level as an input (1.0)

Reference(s): SD #15, page 5

6.13 c or d (1.0)

(a) not a purpose
(b) 56 fixed
(d) 3 - dimensional flux map

Reference(s): SD #35 pp 1-9B-0

6.14 b (1.0)

(a) Correct for Unit 1
(c) ≤600 psia
(d) Correct for Unit 2

Reference(s): 1. Lesson plan #26 "ESFAS"
2. Emergency Op. Proc EOP1-0810040, pp. 6 & 2-0810040 pp.6

6.15 d (1.0)

(a) two out of three - 4th channel is for bypassing
(b) also monitors FW header pressure
(c) components mentioned are controlled by catching relays

Reference(s): SL2 - FSAR - pgs 7.3-15a - 7.3.15d

6.16 b To start 1A1, 1B1 must meet these conditions (1.0)

Reference(s): SD #123, pp 17-24

6.17 d (1.0)

Reference(s): 1. SD #4; pages 37-38

6.18 b or c (1.0)

(a) emergency stop will not
~~(c) only initiated locally~~
(d) 100 RPM, 10 sec.

Reference(s): 1. D-G SD; Control Sequence Engine Control, pg. 3

6.19 d (1.0)

Reference(s): 1. Lecture 52

6.20 d (steam flow signal only) (1.0)

Reference(s): 1. SD 108-REV.0-20

6.21 c (1.0)

(a) wrong input
(b) uses different xmtr
(d) feed reg valve is not a FCE.

Reference(s): 1. Lec. Outline #90, page, 2.

6.22 c - it is automatically unblocked as pressure rises (1.0)

Reference(s): ESFAS System Description - pp 7, 9, 19 and Fig. 7.3.5

6.23 b (1.0)

Reference(s): 1. Lecture outline #73

6.24 Answer

(a) Both (0.5)
(b) Unit 1 (0.5)
(c) Unit 2 (0.5)
(d) Unit 1 (0.5)

Reference: Lecture 47, pp 2 & 3 and Differences Analysis, p. 34

6.25 (b) or (a) (1.0)

Reference: Lecture Outline #46, pp 1, 2, & 4

6.26 Answer

a. False (0.5)
b. False (0.5)
c. True (0.5)
d. True (0.5)

Reference: SL2-FSAR, pp. 11.2-3 & 6

6.27(a) (1.0)

Reference: SD #5, pp. 30 & 31

6.28 ~~(c)~~ (DELETED) ~~(1.0)~~

Reference: Unit 1 - Process RAD Monitor, p.4

7.0 PROCEDURES: NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL - ANSWERS

7.01 1. the steam supply to the turbine seals

2. air in-leakage to the condenser

3. the status of the Circulating-Water pump

4. the ΔT of the Circulating Water across the condenser

5. the Circulating-Water Box prime

6. the Steam-Jet Air-Ejector (SJAE) operation

7. the SJAE loop seal

8. the condition of Feedwater-Heater alternate-dump valves (0.25 each, 2.0 max)

Reference(s): 1. St. Lucie 1&2: Off-Normal Operating Procedure, 2-0610031, Revision No. 0, "Loss of Condenser Vacuum," Section 5.22, pp. 2 of 3.

7.02 1. All clearances have been properly released. (0.5)

2. All tags have been removed and valves, switches, etc. are in their required positions. (0.5)

3. The system has been tested to the extent that it is evaluated as safe to be returned to service. (0.5)

Reference(s): 1. St. Lucie 1&2: Operating Procedure, 0010122, Revision 21, "In-Plant Equipment Clearance Orders," Section 3.4-3, pp. 2 of 22

7.03 d

Reference: EP No. 2 - 0120041, Rev. 8 pg. 6 of 22

7.04 "...to preheat the auxiliary spray." (1.0)

Reference(s): 1. St. Lucie 1&2: Emergency Operating Procedure, 2-0120040, Revision 4, "Natural Circulation/ Cooldown," Section 5.10-8, pp. 7 of 26.

7.05 An ICRR shall be plotted for the following conditions during approach to criticality:

1. After each refueling (0.5) (see OP-0030221, "Initial Criticality Following Refueling").

2. The conditions used in the ECC calculation are questionable and/or unreliable (0.5) due to a lack of steady operation as determined by the NPS.

3. An excessive reactivity anomaly (0.5), which could affect this approach to criticality, has existed since the last time at which criticality was achieved. An "excessive reactivity anomaly" is defined in Regulatory Guide 1.16 and STS 6.9.1.8.d.

Reference(s): 1. St. Lucie 1&2: Operating Procedure, 2-0030126, Revision 1, "Estimated Critical Conditions and Inverse Count Rate Ratio," pp. 2 of 8.

7.06 d. or c. (1.0)

References(s): 1. St. Lucie 182 Off-Normal Oper. Proc 2-0300031, Rev. 2, Sec. 3.1, pp. 1.

2. Lecture outline 52, pp. 8 - hand written note.

7.07 a. 20°F
b. 30%
c. RCS voids (0.5 each)
d. 40%
e. SDC (shutdown cooling)
f. Nuclear Plant Supervisor/Emergency Coordinator

Reference(s): 1. Off-Normal OP-1-0410030

7.08 c (No chloride monitor listed among symptoms) (1.0)

Reference: OP-1-0610030

7.09 <u>Automatic</u>

1. Runback to 60% on loss of one MFW pump (0.5)

~~2. AFW actuation if SG level <34%~~ ~~(0.5)~~

<u>Immediate</u>

3. Ensure S/G levels can be maintained with available MFW or reduce steam demand until levels can be maintained (0.5)

4. If runback occurs, ensure reactor power is matched with turbine power (0.5)

Reference(s): 1. EP 1-0700040, pg. 3

7.10 c (1.0)

Reference: OP 1-200030

7.11 a. False - both units (0.5)

b. True (0.5)

c. False - 2 valves on Unit 1, 3 valves on Unit 2 (0.5)

d. ~~True~~ FALSE (0.5)

Reference(s): 1. EP 1/2 - 0030140
2. EP 1/2 - 0030141
3. EP 1/2 - 0030143
4. EP 1/2 - 0120043

7.12 a. Unit 2 (0.5)

b. Both (0.5)

c. Both (0.5)

d. ~~Unit 2~~ BOTH (0.5)

e. Unit 2 (0.5)

Reference: OP 1/2 - 0250030

7.13 c (1.0)

Reference(s): OP1-220005, pp4

7.14 b You need 4 to go over 1750 psig. This is requirement for going above 275 psig. (Note - d is referenced to going >250°F, but you can't go over 1725 psig without Tavg >250°F without exceeding the 350° ΔT limit between the PZR and Tave.

Reference(s): OP2-0030121 pp 1-5

7:15 (a) False (10 - 500WPCM) (b) True (c) False (2000 CPS)
(d) False - withdraw each group in manual group to 4" then go manual sequential (.5 each)
(e) True

Reference: 1/2-0030122 "Reactor Startup"

7.16 (c) (1.0)

Reference: OP-1-0120020, pp 1 and 2

7.17 (d) (1.0)

Reference: OP-2-1630024, p. 4

7.18 (c) (1.0)

Reference: OP-1-0530021, p. 2

7.19 (b) (1.0)

Reference: OP-1-0510022, p. 1

7.20(a) (1.0)

Reference: OP-2-0210020, pp 1 and 17

7.21 (d) (1.0)

Reference: Off Normal 2-1600030, p. 2

ADMINISTRATIVE PROCEDURES, CONDITIONS AND LIMITATION - ANSWERS

8.01 (a) True (0.5)
(b) True (0.5)
(c) False (0.5)
(d) False (0.5)

Reference: St. Lucie 1&2: Administrative Procedure, Number 0010432, Revision 24.

8.02 Yes, if the following administrative criteria are met: (2.0)

(1) <16 in 24 hr
(2) <24 in 48 hr
(3) <72 hr in 7 days
(4) periodic relief approximately every 4 hrs. at a minimum

Reference: St. Lucie 1&2: Administrative Procedure, Number 0010119, Revision 6, pp. 1 of 3

8.03 a. Unusual Event, fuel element failure (1.0)
b. Site Area Emergency, LOCA (1.0)
c. Alert, S/G TR (1.0)

Reference: Classification of Emergencies, 3100022E, Revision 14

8.04 a. (2.0)

Position		Number Required Unit 1	Number Required Unit 2
SS (SRO)	(+0.2)	1 (+0.2)	
SRO	(+0.2)	1 (+0.2)	1
RO	(+0.2)	2 (+0.2)	2
AO	(+0.2)	2 (+0.2)	2
STA	(+0.2)	1 (+0.2)	

b. The individual must (1.0)

1. have a valid SRO license
2. not be the on-shift STA

Reference: Tech Spec, page 6-5

8.05 OPERATING MODES (3.0)

Operating Mode	Reactivity Contion keff	% of Rated Thermal Power	Average Coolant Temperature
1. Power operation	≥0.99	>5%	≥325°F
2. Startup	≥0.99	≤5%	≥325°F
3. Hot standby	<0.99	0	≥325°F
4. Hot shutdown	<0.99	0	325°F>Tavg>200°F
5. Cold shutdown	<0.99	0	≤200°F
6. Refueling	≤0.95	0	≤140°F

(0.15 each)

Reference: Tech Spec, pages 1-9

8.06 a. True (0.5)
b. True (0.5)
c. False (0.5)

Reference: Tech Specs, pages 6-14

8.07 1. Reactor Control Operators Log (1.5)
2. Equipment Out of Service Log
3. Night Order Log
4. Turbine Operator Log
5. Nuclear Operator Log

(0.3 each)

Reference: AP0010120, page 8 of 25

8.08 a. 8 (2.0)
b. 9
c. ~~2~~ 5
d. ~~5~~ 2
e. 6
f. 4

(0.33 each)

Reference: St. Lucie 1&2: Emergency Plans for St. Lucie Plant, Revision 11, pp. 1-3, 1-4 and 5-3

8.09 b (1.0)

Reference: Tech Spec 3.7.1.5 (Unit 1)

8.10 a (1.0)

Reference: Tech Specs 3.7.1.6 (Unit 2)

8.11 1 - a (0.5)
2 - b (0.5)
3 - a (0.5)
4 - b (0.5)

Reference: Tech Specs 6.9.1.8 and 6.9.1.9

8.12 a. Restore Tavg to greater than or equal to 515 degrees F within 15 minutes (1.0)

b. Be in hot standby within the next 15 minutes (1.0)

Reference: Tech Specs 3.1.1.5

8.13 a. d (Can only be out of service for 72 hours) (1.0)

Reference: Tech Specs 3.8.1.1

8.14 1. Independent verification can be waived in cases of significant radiation exposure (usually >1000 mr/hr) (0.5)

2. For return to service of equipment where functional testing is required to provide operability. (0.5)

Reference: OP0010122, page 2 of 22

8.15 c. Open the valve immediately or be in at least hot standby within 1 hour. (1.0)

Reference: Tech Specs 3.5.1

8.16 a (1.0)

Reference: Tech Specs 3.7.1.5

8.17 d (1.0)

Reference: E-Plan 3100033E, page 13 of 30

8.18 b (1.0)

Reference: AP0010124, page 1 of 9

MASTER

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

Enclosure 3

Facility: St. Lucie 1&2 (335 & 389)
Reactor Type: PWR-CE
Date Administered: 3/5/85
Examiners: Art Johnson/Bruce Wilson
Candidate: _____

INSTRUCTIONS TO CANDIDATE:

Print your name on the line above marked "Candidate." Use separate paper for your answers and write on only (1) side of the paper, unless a specific question instructs you otherwise. Staple this question package to your answers sheets. The grade points available for each question are indicated in parenthesis after the question. The passing grade requires at-least-70% in each of the four (4) categories and at-least-80% for the total grade. The examination questions and answers will be picked up six (6) hours after the examination was started. Read the statement at the bottom of this page; affirm the statement by signing you name.

Category Value	% of Total	Candidate's Score	% of Category Value	Category
~~30~~ 29	~~30~~ 29	_____	_____	1. Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow
~~30~~ ~~29~~ 27	~~30~~ ~~29~~ 27	_____	_____	2. Plant Design Including Safety and Emergency Systems
30	30	_____	_____	3. Instruments and Controls
~~30~~ ~~29.5~~ 28.5	~~30~~ ~~29.5~~ 28.5	_____	_____	4. Procedures: Normal, Abnormal, Emergency, and Radiological Control
~~120~~ ~~112.5~~ 114.5	~~120~~ ~~117.5~~ 114.5	_____		TOTALS
		Total Grade	_____%	

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

_____
Candidate's Signature

1.0 PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW

The following statements apply to Questions 1.01, 1.02, 1.03, 1.04 and 1.05.

The St. Lucie Unit-1 power plant has been operating at steady state 80% of full power for 10 days. All control rods are fully withdrawn (ARO). The fuel burnup status is that the core has reached 6000 EFPH on cycle-6. Use any of the provided figures and tables.

1.01 What is the expected value for the ΔT across the core? Choose the most <u>CORRECT</u> answer from those listed below. (1.0)

(a) 50°F
(b) 46°F
(c) 37°F
(d) 32°F

1.02 On your next shift, you observe that T_c is now higher than the previous (programmed) T_c by 2°F, the reactor coolant flowrate has not changed, the turbine-generator output power has not changed and the power plant is stable; indicate how each of the following parameters have changed (increased, decreased, no change). (2.0)

1. T_h
2. steam flowrate
3. steam temperature
4. steam pressure

1.03 Which one of the following correctly describes the response of core ΔT if the RCS coolant flow rate is reduced while the steam system is controlled to maintain 80% electrical output? (1.0)

a. ΔT will remain the same since the turbine/generator output power has not changed.

b. ΔT will remain the same but nuclear power will increase to provide the same megawatt thermal output.

c. ΔT will increase but nuclear power remains the same to provide the same megawatt thermal output.

d. ΔT will increase and nuclear power must increase to provide more steam flow to the turbine.

1.04 If the control rods are to be inserted while in the manual-sequential (MS) mode until Bank 7 is at 70 inches, and if the boron concentration is to be adjusted to maintain the present power level, calculate the new concentration of boron required for steady operation. Neglect any effect from changes in the Xenon or Samarium concentrations. (2.0)

1.05 How would the movement of rods (Bank 7 from ARO to 70 inches) affect the axial shape index. Explain if ASI becomes more positive or more negative. (1.0)

1.06 If the pressure in the pressurizer is 2250 psia, T_{HOT} = 600°F and T_{COLD} = 550°F, which of the following statements is CORRECT (1.0)

a. Pressurizer temperature = 653°F, RCS is 103°F subcooled
b. Pressurizer temperature = 653°, RCS is 53 °F subcooled
e. Pressurizer temperature = 635°, RCS is 35 °F subcooled
d. Pressurizer temperature = 635°F, RCS is 85 °F subcooled

1.07 Unit-1 is operating at 80% of full power with all-rods-out (ARO) and all parameters equal to their respective programmed values. The boron concentration is 500 ppm. The plant is to be taken to 100% of full power. What is the amount of reactivity that must be added to the core? Answer by choosing the most CORRECT answer from those listed below.

(a) 850 pcm (DELETED)
(b) 700 pcm
(c) 1210 pcm
(d) 580 pcm ~~(1.0)~~

1.08 Figure 1.08 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 is neutron energy, Y is microscopic capture cross section.
(c) X is atom density of U-238, Y is neutron energy.
(d) X is microscopic capture cross section, Y is atom density of U-238.

1.09 Over reactor-core life, the Doppler Coefficient is most affected by what two (2) parameters? Answer by choosing the CORRECT response from those listed below. (1.0)

(a) Lower boron concentration and Pu-239 production
(b) Pu-240 production and increased heat transfer between fuel and cladding
(c) U-238 depletion and lower β_{eff}
(d) U-235 depletion and lower boron concentration

1.10 Gases that are in a solution in the reactor tend to come out of solution in the Pressurizer. Give two (2) reasons for this phenomena. (1.5)

1.11 The reactor is to be taken critical after having been shut down due to a reactor trip from 100% full power. The estimated critical position (ECP) for the rods has been calculated. Consider each of the following situations separately and answer, "Will be actual ECP be HIGHER, the SAME, or LOWER than the calculated ECP?"

a. The operator unintentionally over-feeds a steam generator. (0.5)

b. The actual boron concentration is lower than that used in the calculation for the ECP. (0.5)

c. Startup was delayed by four (4) hours beyond the time used in the calculation for the ECP. A shutdown time of sixteen (16) hours was used in the calculations. (0.5)

d. The steam by-pass/dump pressure set point is reduced 50 psi. (0.5)

1.12 Which one of the following statements is most accurate regarding control rod worth? (1.0)

(a) It is proportional to reactor power.
(b) It is proportional to rod speed.
(c) It is higher in regions of higher relative neutron flux.
(d) It is not dependent upon rod position.

1.13 Which one of the following statements best describes the behavior of Xenon and Samarium? (1.0)

(a) After a reactor trip occurs, Xenon concentration initially increases and Samarium initially decreases.

(b) After a reactor trip occurs, Xenon will eventually decay to a Xenon free condition but a Samarium free condition will not occur until after the next refueling outage.

(c) The Xenon and Samarium peak concentration following a trip occur at a time independent of the previous power level.

(d) Xenon concentrations may increase or decrease when taking the plant from Mode 3 to full power but Samarium will always decrease during this transient after the core's equilibrium Samarium has been reached.

1.14 Which one of the following radioactive isotopes found in the reactor coolant would NOT indicate a leak through the fuel cladding? (1.0)

(a) I-131
(b) Xe-133
(c) Co-60
(d) Kr-85

1.15 A moderator is necessary to slow neutrons down to thermal energies. Which one of the following is the CORRECT reason for operating with thermal instead of fast neutrons? (1.0)

(a) Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

(b) Reactors operating primarily on fast neutrons are inherently unstable and have higher risk of going prompt critical.

(c) The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.

(d) Doppler and moderator temperature coefficients become positive as neutron energy increases.

1.16 Which one of the following causes the soluble poison worth (pcm per ppm) to become more negative? (1.0)

a. Increasing boron concentration and therefore more neutron competition.

b. Increasing boron concentration and therefore less neutron competition.

c. Decreasing boron concentration and therefore more neutron competition.

d. Decreasing boron concentration and therefore less neutron competition.

1.17 During a reactor startup, equal increments of reactivity are added and the count rate is allowed to reach equilibrium each time. Choose the bracketed word(s) that describe what is observed on the Wide Range instruments.

a. The change in equilibrium count rate is [larger] [the same] [smaller] each time. (0.5)

b. The time required to reach equilibrium is [longer] [the same] [shorter] each time. (0.5)

c. The point of supercriticality can be identified by a(n) [increasing] [constant] [decreasing] positive SUR several seconds after the reactivity addition is terminated. (0.5)

1.18 Answer the following TRUE or FALSE.

a. The processes of boiling and condensing water are both constant temperature processes. (0.5)

b. In a typical steam power cycle, the entropy lost in the condenser is always greater than the entropy gained in the steam generator. (0.5)

c. Entropy is a measure of the energy stored in any substance while enthalpy is a calculated property that can be used to find how efficiently a system works. (0.5)

d. It is possible for saturated steam to become superheated through isenthalpic expansion without having to add heat. (0.5)

1.19 Which one of the following is TRUE concerning starting of positive displacement (PD) and centrifugal pumps. (1.0)

a. Neither type of pump should be started with its discharge value shut.

b. Both types of pumps should be started with their discharge values shut.

c. A PD pump should be started with its discharge value shut and a centrifugal pump started with its discharge value open.

d. A PD pump should be started with its discharge value open and a centrifugal pump started with its discharge valve shut.

1.20 Runout of a centrifugal pump is best characterized by which one of the following? (1.0)

a. high motor current, high flow rate and high discharge pressure

b. low motor current, high flow rate and low discharge pressure

c. low motor current, low flow rate and high discharge pressure

d. high motor current, high flow rate and low discharge pressure.

1.21 Which one of the following statements about Net Positive Suction Head (NPSH) is <u>INCORRECT</u>? (1.0)

a. NPSH is the amount by which the suction pressure is greater than the saturation pressure of the water being pumped.

b. NPSH is essential for operation of centrifugal pumps but not for positive displacement pumps.

c. NPSH can be calculated by subtracting the saturation pressure from the actual suction pressure.

d. When a pump is started, the NPSH will decrease by the amount of the pressure drop in the suction piping.

1.22 Which one of the following is the <u>CORRECT</u> order of the heat transfer processes as heat flux increases? (1.0)

a. bulk boiling, sub-cooled nucleate boiling, film boiling, DNB
b. sub-cooled nucleate boiling, bulk boiling, film boiling, DNB
c. bulk boiling, sub-cooled nucleate boiling, DNB, film boiling
d. sub-cooled nucleate boiling, bulk boiling, DNB, film boiling

1.23 Heat balances can be calculated using the change in enthalpy for water and steam flowing through the steam generators. Select the CORRECT statement. (1.0)

a. Feedwater although subcooled, is assumed to be saturated water since the enthalpy difference is very small.

b. The enthalpy of superheated steam from the MSRs must be included with the enthalpy of the SG saturated steam

c. The loss in enthalpy due to steam generator blowdown is usually small enough to be neglected.

d. Any changes in the recirculation ratio in the steam generators must be factored into the enthalpy changes.

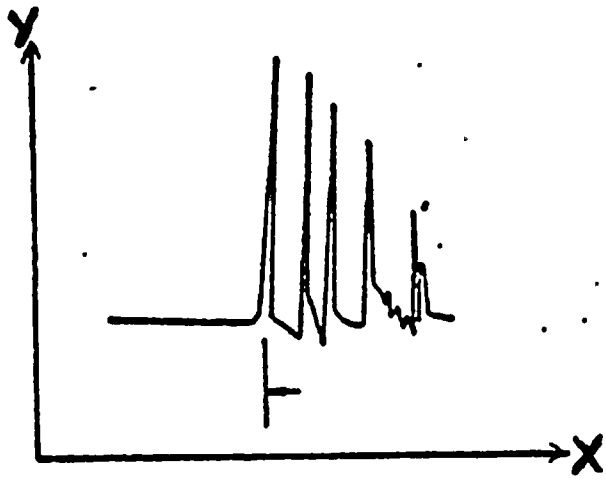
1.24 Which one of the following is NOT part of the accident postulated for the basis of the shutdown margin requirement? (1.0)

a. Main Steamline break
b. Beginning-of-Life (BOL) condition
c. Tavg at no load operating temperature
d. Most reactive rod stuck out

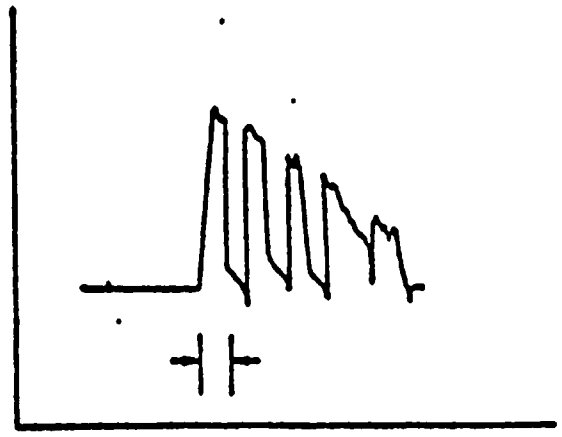
1.25 Which one of the following is NOT one of the DNB related parameters that must be maintained within Tech Spec limits? (1.0)

a. Hot leg temperature
b. Pressurizer pressure
c. Reactor Coolant System total flow rate
d. Axial Shape Index

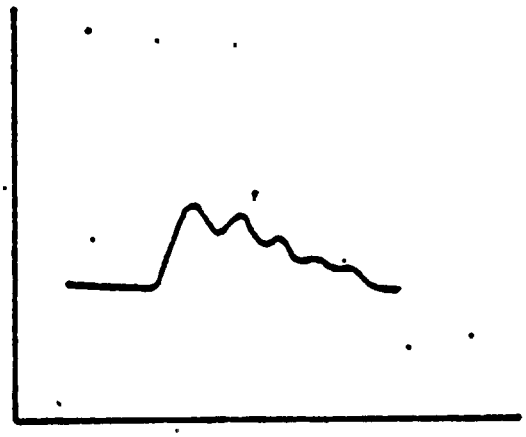
FIGURE 1.08



(A) RESONANCE REGION AT LOW ABSORBER TEMPERATURE



(B) RESONANCE REGION WITH INCREASED ABSORBER TEMPERATURE. (SMALL DOPPLER BROADENING)



(C) RESONANCE REGION WITH LARGE DOPPLER EFFECT

2.0 PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS

2.01 Which one (1) of the following statements regarding the Feedwater System is INCORRECT? (1.0)

(a) Feedwater heater train A is usually connected to moisture separator reheater's (MSR) 1C and 1D while feedwater heater train B is associated with MSRs 1A and 1B.

(b) For feedwater heater train B, extraction steam is supplied from the low pressure turbine 1B to the number 1B, 2B and 3B feedwater heaters only.

(c) All of the feedwater heaters have non-return valves in their extraction steamlines to prevent backflow of steam from the feedwater heaters to the turbines on a turbine trip.

(d) Only the number 4 feedwater heater has no shell side discharge level control valve, using a drain cooler and heater drain pumps instead.

2.02 Which one of the following is NOT a component cooled by the Turbine Cooling Water (TCW) System? (1.0)

(a) hydrogen-seal oil coolers
(b) secondary-system chemical analyzer
(c) condensate pump motor-bearing coolers
(d) feedwater pump seal and stuffing-box coolers

2.03 Which statement below accurately describes a characteristic of the D-C Power Distribution System? (DELETED) ~~(1.0)~~

(a) Unit 1 has four battery buses while Unit 2 has six battery buses.

(b) There are only three battery chargers that can be utilized for DC power at Unit 1.

(c) The battery chargers for Unit 2 can be picked up by the emergency diesel generators in 13 seconds on a loss of off-site power, whereas the chargers for Unit 1 take 40 seconds to be picked up by the diesels.

(d) A mechanical interlock in the DC power switchgear allows the batteries to be connected to their associated DC bus after the load bank breaker is closed.

2.04 Select the INCORRECT statement concerning the Instrument Air System. (1.0)

(a) On loss of instrument air, the backup air compressor will start at approximately 85 psig.

(b) At about 80 psig decreasing, the cross-connect capability from Unit 1 to Unit 2 is lost.

(c) If the backup compressor automatically starts, it must be manually stopped when air pressure is restored.

(d) Following a blackout, the air compressors must be locally reset on both units before being restarted.

2.05 During normal operation of the Component Cooling Water (CCW) System, which one of the following statements is INCORRECT? (1.0)

(a) The "N" header supply and return valves will automatically close upon receipt of an SIAS.

(b) Pump C is not normally running, but its breaker is racked in and the C pump's return discharge lines are tied into the B return and discharge headers.

(c) The "N" header is supplied from both the A and B headers.

(d) Flow through the letdown heat exchanger is manually adjusted to obtain a flow of approximately 8500 gpm.

2.06 Which one of the following is NOT a design basis of the main condenser? (1.0)

(a) Serve as a heat source for low pressure heaters 1A/1B and 2A/2B which are located in the neck of each of the condenser shells.

(b) Condense 100% of the full load main steam flow and deaerate the condensate before it leaves the condenser hot well.

(c) Provide for removal of noncondensable gases from the condensing steam through the main condenser evacuation system.

(d) Provide for deaeration of condensate makeup water.

2.07 Which one of the following statements regarding the 120 Volt instrument and vital AC systems is TRUE? (1.0)

(a) The normal source of 120 VAC vital is from 480 VAC MCC 1AB via step down and regulating SOLA transformers to the static switch and transfer switch to vital AC panel No. 1A.

(b) Unit 1 has 2 vital AC buses, while Unit 2 has only 1 vital AC bus.

(c) Both Units 1 and 2 normally utilize two 125 V DC buses to supply power to static inverters that feed eight 120 VAC instrument buses.

(d) The maintenance bypass transformers for providing alternate power to the 120 VAC instrument buses actually consist of two transformers, one to lower the voltage from 480 VAC to 120 VAC and one to stabilize and regulate the voltage.

2.08 Which one of the following is an INCORRECT statement concerning the Main Turbine? (1.0)

(a) A blow out plug is mounted on the turbine exhaust cylinder cover and provides automatic emergency pressure relief should the internal pressure rise beyond the maximum safe value.

(b) LP Turbine exhaust hood spray is initiated by temperature control valves which control the flow of water from the condensate pump discharge.

(c) When bringing the turbine up from an idle condition the governor valves are shut and the reheat stop valves, interceptor valves and throttle valves are full open.

(d) The reheat stop valve functions as an additional safety device to prevent overspeeding the turbine should the interceptor valve fail to close.

2.09 Select the INCORRECT statement concerning the Intake Cooling Water System (ICW). (1.0)

(a) The power supply for pump 1C is the "AB" bus, which normally is lined up to receive power from the "B"network.

(b) Upon loss of off-site power, bearing lube water for the ICW pumps will not be interrupted because of the backup supply from the domestic water system.

(c) Upon loss of off-site power, if all three ICW pumps are available for starting, pump 1C is not started to avoid overloading the diesel generators.

(d) All three ICW pumps receive an auto start signal upon SIAS.

2.10 Which statement regarding the Air Evacuation System is CORRECT? (1.0)

(a) The Steam Jet Air Ejector's (SJAE) are two-stage, twin element jet air ejectors utilized to draw vacuum during initial secondary plant start up.

(b) Hogging ejectors are used in both secondary plant startup and in normal secondary plant operations due to their large capacity and flexible control features.

(c) The priming ejectors for the waterbox priming system are used, in practice, to draw a vacuum during startup, though the auxiliary priming ejectors were designed for this purpose.

(d) When putting the SJAEs in service, the second stage air ejector is put in service prior to the first stage air ejector.

2.11 Which one of the following is an INCORRECT statement regarding the Main Steam System? (1.0)

(a) Both Unit 1 and Unit 2 have two manual/electrical atmospheric dump valves which allow removal of core decay heat equivalent to 8% power.

(b) Only Unit 1 has a main steam check valve to prevent backflow from the other steam generator.

(c) The Main Steam Isolation Valves (MSIV) fail open on loss of electric power to the air solenoids but fail shut on loss of air supply.

(d) Sixteen safety valves for overpressure protection are associated with each unit's Main Steam System.

2.12 Which one of the following is a CORRECT statement concerning the Component Cooling Water (CCW) system differences between Units 1 and 2? (1.0)

(a) A low level in the CCW System surge tank will isolate the nonessential header at Unit 1, while this is not the case at Unit 2.

(b) The fuel-pool heat exchanger is supplied from A or B header at Unit 2. It is supplied by the non-essential header at Unit 1.

(c) The A and B headers at Unit 1 supply CCW to the Control-Room air conditioners. At Unit 2, the Control-Room air conditions are air cooled.

(d) The instrument air compressor (inside containment) at Unit 1 is supplied with CCW from the non-essential header. At Unit 2, it is supplied with CCW from the essential header.

2.13 Which one of the following is an INCORRECT statement concerning the Chemical Volume Control System differences between Units 1 and 2? (1.0)

(a) RCP seal water bleedoff to the VCT has two solenoid operated isolation valves on Unit 2. Unit 1 has one air operated isolation valve and one solenoid operated isolation valve.

(b) Unit 2 has an additional letdown isolation valve - air operated valve V-2522 - located outside the containment upstream of the letdown control valves.

(c) Unit 2 has an additional charging isolation valve - air operated valve V-2523 - located outside the containment down stream of the charging flow element.

(d) Unit 1 combined boric acid discharge valve-V-2161 is an air operated valve with a control switch on RTGB 105. On Unit 2 V-2161 is a manual valve.

2.14 Which one of the following is an INCORRECT statement concerning the Containment Spray System differences between Units 1 and 2? (1.0)

(a) Unit 1 containment spray pumps require component cooling water.

(b) Unit 2 containment spray pumps require component cooling water.

(c) Unit 1 uses NaOH for post LOCA iodine control.

(d) Unit 2 uses hydrazine for post LOCA iodine control.

2.15 Which one of the following is an INCORRECT statement concerning the purposes of the Fuel Pool Cooling and Purification System for Unit 1? (1.0)

(a) Maintain the water level a minimum of five feet above the top of the fuel during fuel handling and storage operations.

(b) Maintain purity and optical clarity of the fuel pool water.

(c) Maintain purity of the water in the refueling cavity and in the refueling water tank.

(d) Remove decay heat from the spent fuel and maintain pool water temperature less than 150°F.

2.16 Which one of the following instrumentation DID NOT already exist in all CE designed reactors, concerning the Unit 2 Inadequate Core Cooling instrumentation? (1.0)

(a) Pressure transmitter on the pressurizer
(b) RTDs in the hot and cold legs.
(c) Pairs of heated and unheated junction thermocouples.
(d) Core exit thermocouples.

2.17 a. When the Unit 1 Shutdown Cooling System is in operation to reduce the temperature of the primary coolant, the RCS pressure in the Pressurizer should be less than _____psia and the RCS temperature should be less than _____°F. (1.0)

b. Specify whether the Pressurizer pressure indication would be GREATER than, the SAME as, or LESS than the suction pressure in the Shutdown Cooling System. Explain your answer. (1.0)

2.18 What are two (2) purposes of the Quench Tank? (1.0)

2.19 The High Pressure Safety Injection (HPSI) System at Unit 1 is properly setup in Normal System Alignment (is in standby and lined up for emergency operation). Choose the one CORRECT statement. (1.0)

(a) Eight HP safety injection valves, HCV3626, HCV3627, HCV3636, HCV3637, HCV3646, HCV3647 are open.

(b) The RWT outlet valves (MV071A and B) are open.

(c) The containment sump outlet valves (MV072A and B) are open.

(d) HPSI discharge valves (HCV3653, HCV3654, HCV3655 and HCV3656) are locked open.

2.20 Which one of the following is an INCORRECT statement concerning the components of the safety injection tanks as it applies to Unit 2 versus Unit 1? (1.0)

(a) Nitrogen supply valve to tank is AOV.
(b) Tank fill and drain valve is AOV.
(c) SIT isolation valve is MOV.
(d) Loop check valve backleakage test valve is AOV.

AOV - air operated valve
MOV - motor operated valve

2.21 Which one of the following is NOT a function of the steam bypass control system (SBCS)? (DELETED) ~~(1.0)~~

(a) It provides a method of automatically controlling reactor coolant temperatures during plant startup.

(b) It prevents opening the safety valves and effects a smooth transition to hot standby conditions following a unit trip.

(c) It provides a method of maintaining steam generator pressure during hot standby.

(d) It provide a method for decay heat removal during cooldown.

2.22 Which statement below regarding the condensers is CORRECT? (1.0)

(a) The main condenser consists of two 50% capacity, divided water boxes, single pass surface condensers with the tubes arranged parallel to the turbine shaft, and each condenser shell containing one tube bundle.

(b) The condenser hotwells have the storage capacity to provide six minutes of operation at full flow.

(c) The low pressure heaters in the neck of each condenser shell, draw off extraction steam for use in heating condensate passing through U-tubes.

(d) The number of tubes in the condenser increase towards the periphery of the shell. This allows the free flow area between the tubes to increase towards the center and increase steam velocity due to the reduction in steam volume as it condenses.

2.23 Which statement below concerning the auxiliary steam system is CORRECT? (1.0)

(a) There is one supply line each from main steam header A and main steam header B.

(b) Unit 2's machine shop decon station is supplied from aux steam.

(c) The aux steam system provides 400 psig steam to the auxiliary priming ejectors for the water boxes

(d) There is no automatic control of auxiliary steam to the hogging ejectors.

2.24 Which statement regarding the turbine lube oil system is INCORRECT? (1.0)

(a) The bearing oil pump is a centrifugal pump, which does not require priming prior to operation.

(b) When selected to auto, the bearing lift pump is used to supply oil to the turbine bearings at low turbine speeds (<400 rpm and decreasing).

(c) The HP Seal Oil Backup Pump is the first backup pump to start if the Bearing Oil Pump cannot maintain system pressure.

(d) The HP Seal Oil Backup Pump and the Bearing Oil Pump utilize the same motor controller switch to select pump control status.

2.25 Which one of the following is an INCORRECT statement concerning the inputs into the Reactor Regulating System as it applies to Unit 2 versus Unit 1? (1.0)

(a) Each RRS is supplied with two cold leg temperature signals, one for each reactor coolant loop.

(b) Each RRS is supplied with two hot leg temperature signals, one for each reactor coolant loop.

(c) Turbine power is transmitted to the RRS in the form of a turbine first stage pressure signal.

(d) Each RRS cabinet contains a power range control channel from an axially split out-of-core detector.

2.26 Which one of the following is an INCORRECT statement concerning normal operation of the Unit 1 Main Power Distribution System? ~~(1.0)~~

(DELETED)

(a) If the 1B1 Station Service Transformer is out is service, then the 480 V 1A1 bus can be connected to the 480 V 1A2 bus such that the 1A1 Station Service Transformer feeds all of the "normal" 480 V loads.

(b) The turbine area 480 V MCC 1C can be fed from either the 480 V 1A1 or 1A2 buses.

(c) The 480 V 1A2 can be fed from either 480 V bus 1A1 or 1B1 but is normally aligned with 1B1.

(d) Both Emergency Diesel Generators will be operable with their output breakers on the 1A3 and 1B3 4.16 KV buses racked-in, but in the open position for standby service.

2.27 Which statement below regarding Unit 1 CVCS is CORRECT? (1.0)

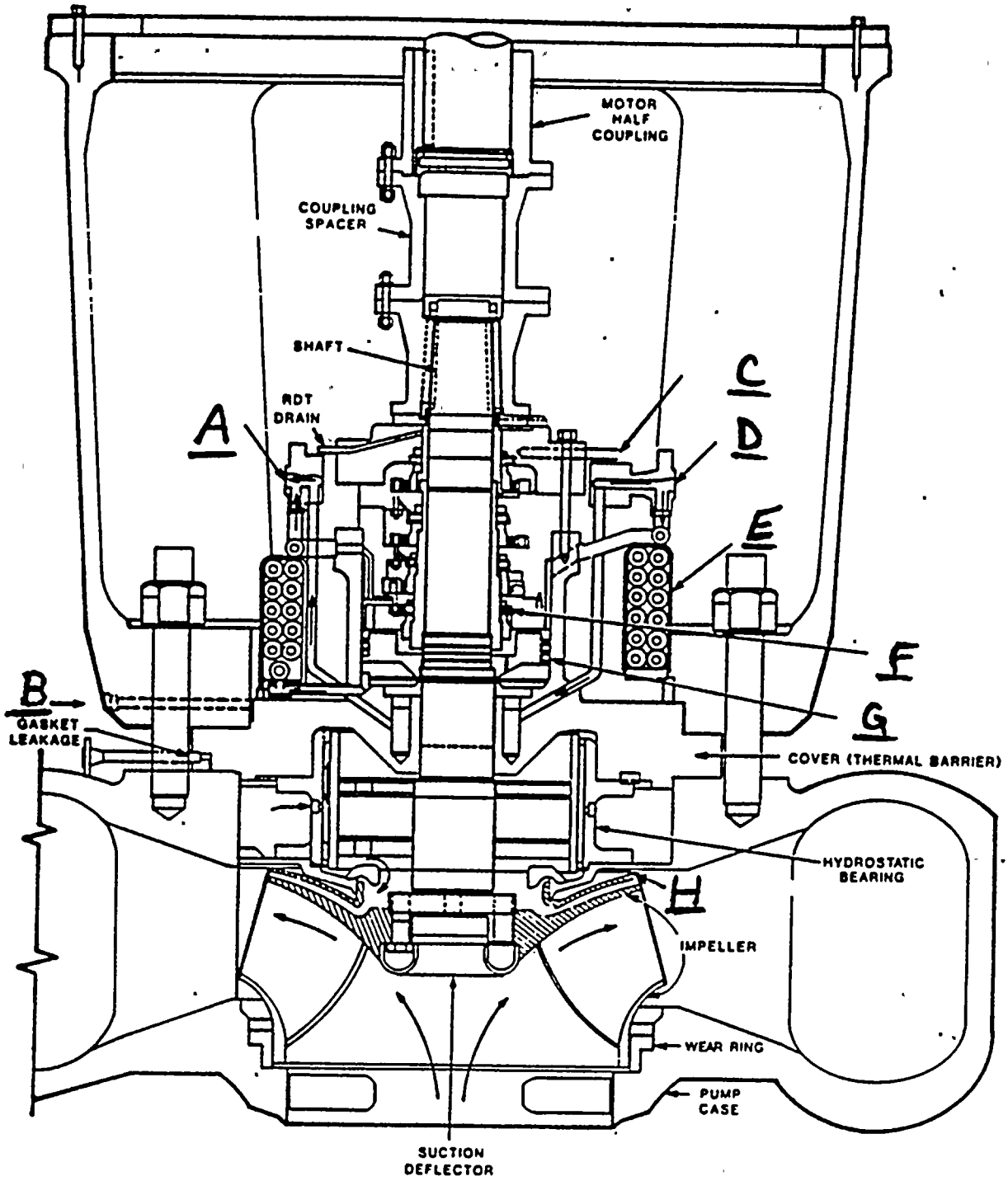
(a) The letdown flow path exits the 1A1 cold leg, passes through the shell side of the regenerative heat exchanger, then through a letdown control valve, the tube side of the letdown heat exchanger, a letdown isolation valve and the letdown backpressure valve before filtration and purification occur, finally being sprayed into the VCT.

(b) The letdown flow path exits the 1B1 cold leg, passes through the tube side of the letdown heat exchanger, then through the letdown backpressure valve, tube side of the regenerative heat exchanger, letdown control valve, before filtration and purification occur, finally being sprayed into the VCT.

(c) The letdown flowpath exits the 1A1 cold leg, passes through the tube side of the regenerative heat exchanger, a letdown control valve, the tube side of the letdown heat exchanger, the letdown isolation valve, before filtration and purification occur, finally being sprayed into the VCT.

(d) The letdown flow path exits the 1B1 cold leg, passes through the tube side of the regenerative heat exchanger, a letdown control valve, the tubeside of the letdown heat exchanger, the letdown backpressure valve, before filtration and purification occur, finally being sprayed into the VCT.

2.28 Below is a drawing of Reactor Coolant Pump Internals. Identify the RCP components labeled A-H. (.25 each)



A: _____ B: _____ C: _____

D: _____ E: _____ F: _____

G: _____ H: _____

(a) Reciruclating Impeller
(b) Auxiliary Impeller
(c) Integral Heat Exchanger
(d) Mechanical Seals
(e) Cooling Water Outlet
(f) Seal Injection Inlet
(g) Control Bleedoff
(h) Cooling Water Inlet

3.0 INSTRUMENTS AND CONTROL

3.01 The power plant has been operating at a steady 100% of full power for 10 days, one (1) charging pump is running, the Pressurizer level is 0% (with respect to the programmed level setpoint), the letdown flowrate is 40 gpm and all of the controllers are in auto. What changes should occur, if any, in the CVCS and/or what actions should the CVCS take as the pressurizer level slowly decreases to those values <u>indicated</u> below? Note any differences between Unit 1 and 2.

a. -1% (0.5)
b. -2% (0.5)
c. -3% (0.5)
d. -4% (0.5)
e. -5% (0.5)

3.02 For the Control Element Drive System (CEDS), list the four (4) Reactor Protection System (RPS) pre-trips that (with 2-out-of-4 logic) will prevent the withdrawal of a Control Element Assembly (CEA) with the CEDS in any control mode. (1.0)

3.03 What automatic actions (other than alarms) occur (if any) when the following Process Radiation Monitors exceed their setpoints?

a. Liquid-Discharge Monitor (0.5)
b. Steam-Generator Blowdown Monitor (0.5)
c. Letdown Process Monitor (0.5)
d. Component-Cooling-Water Monitor (0.5)

3.04 Which one of the following statements is <u>CORRECT</u> regarding the operating modes of the CED? (1.0)

(a) In the manual group mode, a regulating group of CEAs can be lowered if all the shutdown groups are at their lower limit as indicated by green illumination of the shutdown CEA indicators.

(b) In the automatic sequential mode, if a slow rate signal occurs, all regulating group programmers sequence their associated CEAs at approximately 10% of the normal sequencing rate.

(c) In the automatic sequential mode, the automatically controlled group can be overridden by selecting that group and operating the manual control switch on the control panel.

(d) In the manual individual mode, if a CEA withdrawal prohibit signal is received, a shutdown CEA can be raised only if this inhibiting function is overridden via the inhibit bypass controls.

3.05 Which one of the following reactor trips DOES NOT receive an input from the core protection calculators? (1.0)

(a) Thermal margin/low pressure
(b) Local power density
(c) High rate of change of power
(d) Variable over power

3.06 Which one of the following is NOT a specific input for the reactor regulating system? (1.0)

(a) Cold leg temperature from two RTDs per loop for Unit 1
(b) Turbine first stage pressure
(c) Pressurizer level
(d) Reactor power from an out-of-core detector

3.07 Which statement below is CORRECT regarding the RRS? (1.0)

(a) A reduction in turbine load is sensed by the Tavg calculator, which causes Tavg to rise above Tref, resulting in an insertion signal from the CEA status bistable.

(b) The RRS can handle step changes in power of up to 10% or a ramp change in power of no more than 3% per minute.

(c) If the Tavg signal is noisy, compensation for this effect is accomplished through the use of a manually inserted compensatory voltage signal.

(d) Both a power error signal and a temperature error signal are sent to the reactor control unit calculator to generate the CEA speed signal.

3.08 Which one of the following best describes Unit 2 incore instrumentation? (1.0)

(a) One of the main purposes is to provide an accurate source-range neutron detection system during reactor startups following extended shutdowns.

(b) There are 80 fixed detector assemblies and two moveable detectors.

(c) The fixed and moveable detectors can aid in calibration of the excore detectors by providing power distribution information.

(d) In each detector assembly, there are four self-powered rhodium detectors which measure the neutron flux distribution and provide a two-dimensional axial flux mapping of the core.

3.09 The Engineered Safety Feature Actiuation System (ESFAS) has five (5) functions which are initiated during various plant conditions. Which one of the following is a correct actuation signal for the indicated function and unit? (1.0)

(a) Unit 2 SIAS - Pressurizer Pressure $\leq$1600 psia or containment pressure $\geq$5 psig.

(b) Unit 1 CSAS - SIAS and Containment Pressure $\geq$10 psig.

(c) Unit 2 MSIS - S/G pressure $\leq$500 psia or containment pressure $\geq$5 psig.

(d) Unit 1 RAS - RWT level $\leq$6 ft.

3.10 Which statement below about the Unit 2 auxiliary feedwater actuation signals (AFAS) is correct? (1.0)

(a) The AFAS logic employs a two out of four actuation sequence of system components, despite having only three channels of initiating signals, through the use of a manually controlled fourth channel.

(b) The parameters monitored by the AFAS initiation circuits are feedwater flow 1 and 2, steam geneator level 2A and 2B and steam generator pressure 2A and 2B.

(c) The cycling relays control the auxiliary feedwater pumps and the main feedwater isolation valves and will automatically reset when a steam generator is refilled.

(d) If loss of inverter output power to two AFAS channels occur, the battery fail bypass actuates and bypasses one of the affected channels creating a one-out-of-two trip logic.

3.11 Which statement below, regarding the circulating water system is <u>INCORRECT</u>? (1.0)

(a) When a circulating pump is started, its corresponding discharge valve automatically opens to 30% and then fully opens 15 minutes later if the pump is still running.

(b) In order to start circ water pump 1A1, the discharge valve for circ water pump 2A2 must either be shut or fully open with circ pump 2A2 running.

(c) If a circ water pump is started with its discharge tunnel already being supplied by the other common circ pump, then it takes only five minutes for the second circ pump's discharge valve to open.

(d) If lubricating water flow to an idle circulating pump is less than 8 gpm, the pump cannot be started.

3.12 Which one of the following is NOT directly affected by the Nuclear Instrumentation Systems (NIS) 15% bistable? (1.0)

(a) High startup trip rate circuitry
(b) Local power density trip circuity
(c) Reactor trip on loss of turbine circuitry
(d) Thermal margin/low pressure trip circuitry

3.13 The NIS monitors reactor power in a range from _____% to _____% power. In Unit 1 there are ____ channels of instrumentation and _____ channels in Unit 2. Unit 1 utilizes a total of _____ wide range fission chambers consisting of ____ fission tubes per detector. The major difference in the types of detectors used in the two plants is that unit 2 has _____ type detectors for the purpose of ____. (2.0)

3.14 Select the CORRECT statement concerning the Diesel Generators. (1.0)

(a) Under an automatic start signal only an overspeed trip, "86" generator fault or emergency stop pushbuttons will shutdown the unit.

(b) The "Emergency Stop" pushbutton on the engine control panel door, the "Emergency Stop" pushbutton on either of the engine terminal box doors or the "86" (generator lockout) switch can be used to shutdown the unit in an emergency.

(c) The Normal Stop can be initiated remotely or locally when the unit is running without an automatic signal.

(d) If after 10 seconds of air start motor operation, the engine has not reached 600 RPM, the "fail-to-start" circuit will be energized and the engine will shutdown/lockout.

3.15 Component Cooling Pumps 1A and 1B have a control room START-AUTO-STOP switch and two local switches on the respective switchgear; ISOLATE-NORMAL and CLOSE-TRIP, and local pump motor STOP-START pushbuttons. Select the CORRECT statement concerning these four switches. (1.0)

(a) With the ISOLATE-NORMAL switch in NORMAL, both the control room switch and the switchgear CLOSE-TRIP switch can be used to start or stop the pump.

(b) With the ISOLATE-NORMAL switch in ISOLATE, the control room switch, automatic actuation features and the switchgear mounted CLOSE-TRIP switches are rendered inactive.

(c) The automatic actuation features on the Pumps will function with the ISOLATE-NORMAL switch in either position.

(d) With the ISOLATE-NORMAL switch in NORMAL, the local switchgear CLOSE-TRIP switch is rendered inactive.

3.16 Select the CORRECT statement concerning input signals to the Reactor Regulating System (RRS). (1.0)

(a) Each RRS is supplied with four Tc signals, two for each loop, in the form of 4-20 ma current signals, representing 515-615°F.

(b) The turbine power signal used by the RRS to compute Tref is also used to compute a power error signal for use in automatic CEA control.

(c) The hot leg temperature signals are auctioneered and averaged with the Tc signals to provide Tavg.

(d) If either section of the axial split power range control channel fails, the remaining signal is automatically doubled for input to the RRS.

3.17 Select the INCORRECT statement concerning the input signals to the Steam Bypass Control System (SBCS). (1.0)

(a) The SBCS receives steam header pressure signals from two independent transducers.

(b) The SBCS monitors the four undervoltage relays (of the RPS) whose contacts close on a reactor trip.

(c) The SBCS receives the Tavg signal from the RRS.

(d) The SBCS receives the steam flow - feed flow mismatch signal from the feedwater regulating system.

3.18 Which one of the following statements concerning the Steam Bypass Control System is INCORRECT? (1.0)

(a) The Emergency Off Switch in the RRS cabinet enables the operator to force all bypass valves closed regardless of whether the system is in the auto or manual mode.

(b) If the Steam Bypass Permissive Switch on the Main Control Board is in the Off mode, the bypass valves cannot be opened manually or automatically.

(c) To remove the condenser vacuum interlock, the operator must depress the Emer Off/Cond. Vac. Interlock Reset Pushbutton regardless of whether the M/A control stations are in auto or manual.

(d) Once the Emergency Off Switch in the RRS cabinet is enabled, the bypass valves cannot be operated until the system is reset using the reset switch, located on the cabinet face.

3.19 Which one of the following will stop an operating Feedwater Pump? (1.0)

(a) With both Feedwater Pumps operating and total feedwater flow about 40%, one of the two operating condensate pumps trips.

(b) Operating feed pump suction pressure falls to 300 psig (after a 5 second delay).

(c) 30 seconds after the feed pump is started, feedwater pump suction flow is at the "Lo-Lo" setpoint.

(d) The operating feed pump lube oil pressure drops to 6 psig (10 second time delay).

3.20 The Metrascope, besides being the primary means for CEA (control element assembly) position indicator, also generates several alarm/interlock signals. Indicate the alarm/interlock below which is NOT generated by the Metrascope. (1.0)

(a) AWP - Automatic Withdrawal Prohibit
(b) ISH - Regulating Group Withdrawal Permissive
(c) Group deviation alarm
(d) IRG - Shutdown Group Insertion Permissive

3.21 With power level 100% and steam generator level control in manual operation, level starts to increase and no operator action is taken. Which one of the following events should occur at the denoted steam generator level? (1.0)

(a) Turbine trips at 95% SG level.
(b) Feedwater regulating valves receive a "close" signal at 82% SG level.
(c) High level alarm occurs at 80% SG level.
(d) The 100% feedwater bypass valves close at 85% SG level.

3.22 Which statement below is CORRECT for the normal operation of the bypass feedwater regulating system below 15% power. (1.0)

(a) The input signal is steam flow and the final control element is the feedwater bypass valve.

(b) The input signal is steam generator level from the same transmitter that is used by the 3-element control system.

(c) A proportional and reset controller is used to control feedwater flow to maintain S/G level equal to a setpoint.

(d) The input signal is steam generator level and the feedwater regulating control valve and the feedwater bypass valves are the final control elements.

3.23 Which statement below, regarding the engineered safety features actuation system (ESFAS) is INCORRECT? (1.0)

(a) An SIAS must occur in order to energize the relays allowing CSAS to actuate, even if containment pressure exceeds its actuation setpoint.

(b) The MSIS can be initiated by two out of four low pressure signals from either set of steam generator pressure transmitters.

(c) The SIAS block to permit shutdown depressurization is manually inserted once the "block permissive" annunciator is actuated, as pressure drops, and manually unblocked when pressure rises above the "low pressurizer pressure" setpoint.

(d) A block for both the SIAS and MSIS functions can only be achieved when three out of four channels have reached a permissible valve, actuating the appropriate block annunciator.

3.24 Which of the following is INCORRECT with respect to the Digital Electro-Hydraulic (DEH) turbine control system? (1.0)

(a) The low bearing oil pressure trip actuates at 5-7 psig.
(b) The overspeed trip mechanism will dump auto stop oil at a turbine speed of 1908 rpm.
(c) Primary lockout and backup lockout will cause the solenoid trip to actuate and dump auto stop oil.
(d) The low vacuum trip will open the trip valve at 2-3 psig when "latched" and at 18-22 in. hg when "unlatched."

3.25 Match the reactor coolant system annuciator or control function in column A with the appropriate setpoint in column B. (2.5)

Column A	Column B
____ Unit 1 "Select RCS Low Range PORV Operation" (0.5)	(a) 415 psia
	(b) 460 psia
	(c) 279°F
____ Pressurizer backup heaters deenergize (0.5)	(d) 2400 psia
	(e) 2225 psia
____ Unit 2 PORV Trip-Open signal from LPRT (0.5)	(f) 195° F
	(g) 2350 psia
____ Unit 1 OMS PORV Actuation Setpoint (0.5)	(h) 465 psia
	(i) 225°F
____ Reactor Coolant Pump Motor High Temperature Alarm (0.5)	

4.0 PROCEDURES: NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL

4.01 While operating a 100% of full power, St. Lucie Unit 2 experiences a slow decrease in the condenser vacuum. List (8) things that could be checked to determine the cause of the decrease in the condenser vacuum. (2.0)

4.02 List the three (3) steps that must have been completed so that a system, that had been tagged-out for maintenance, can be considered to be "ready for service." (1.5)

4.03 Which one of the following is a <u>CORRECT</u> statement of a subsequent action in the Steam Generator Tube rupture procedure, EP 2-0120041? Assume the reactor is shutdown and SIAS is not received. (1.0)

a. If an SIAS has not been received, do not isolate letdown.
b. Ensure condenser air ejector vent is isolated.
c. Ensure Blowdown on affected S/G is aligned to Monitor Storage Tanks.
d. Stop one Reactor Coolant Pump in each loop.

4.04 In the Emergency Operating Procedure, 2-0120040, "Natural Circulation/Cooldown," there is a step during cooldown which states, When using auxiliary spray to decrease the Pressurizer pressure, maximize the use of letdown flow through the Regenerative Heat Exchanger, when available, ..." What is the reason for this instruction? (1.0)

4.05 List three (3) conditions for which an Inverse Count Rate Ratio (ICRR) shall be plotted during an approach to criticality at St. Lucie Unit 2. (1.5)

4.06 While operating at 100% of full power on Unit 2, an increase in Component Cooling Water (CCW) is observed on the indicators PLP-101 and PLP-102. This is followed by an indicated rise in the level of the CCW surge tank. Which of the following is <u>NOT</u> a potential source of the activity in the CCW system? (1.0)

a. Letdown heat exchanger
b. Sample heat exchangers
c. Shutdown cooling heat exchangers
d. Low Pressure safety injection Pumps

4.07 Complete the following statements concerning HPSI termination criteria as contained in the "HPSI-Off Normal Operation Procedure," OP1-0410030.

a. RCS is maintained _____ subcooled (0.5)

b. Pressurizer pressure and level is controllable with indicated level > _____% and stable. (0.5)

c. No indication of _____. (0.5)

d. S/G level is controllable with indicated wide range level > _____% and stable. (0.5)

e. _____ equipment is available and entry conditions can be established by RCS cooldown procedures. (0.5)

f. Permission is obtained from the _____. (0.5)

4.08 Which one of the following is NOT a symptom of condenser tube leak as contained in Off-Normal OP-1-0610030, "Secondary Chemistry - Off Normal"? (1.0)

a. Increase in cation conductivity in the condensate header
b. IA S/G specific conductivity increasing
c. Increase in hotwell chloride monitor
d. Hotwell quadrant cation conductivity increasing or alarming

4.09 Assume Unit 1 is operating at 100% power when a main feedwater pump trips. List the expected Automatic Actions and your Immediate Actions assuming the transient does not cause a reactor trip. (2.0)

4.10 Which one of the following is an INCORRECT immediate action in OP 1-2000030, "Loss of Reactor Cavity Cooling Fans or Reactor Support Fans?" (1.0)

a. If one cavity cooling fan or one support cooling fan has been lost, attempt to restart the failed fan to determine operability.

b. If both cavity cooling fans or both support cooling fans have been lost and one or both fans cannot be restarted immediately initiate a plant shutdown per OP 1-0030125, "Turbine Shutdown, Full Load to Zero Load."

c. If both cavity cooling fans or both support cooling fans have been lost and one or both cannot be restarted, notify Duty Call Supervisor and continue plant operation while carefully monitoring TR-25-1 and 2.

d. If one cavity cooling fan or one support cooling fan has been lost and is declared inoperable, notify the Duty Call Supervisor.

4.11 Answer the following questions TRUE or FALSE concerning the differences in Emergency Procedure Immediate Actions between Units 1 and 2.

a. Following a blackout, you must place reheater control system in manual, then close TCVs on Unit 1 but not Unit 2. (0.5)

b. On Control Room Inaccessibility, you must take the Remote Shutdown Room Keybox Master Key with you on Unit 2 but not Unit 1. (0.5)

c. On Total Loss of AC Power, the actions taken to isolate letdown flow on both units are identical. (0.5)

d. On Inadequate Core Cooling you are required to verify natural circulation on Unit 1 but not on Unit 2 (0.5)

4.12 For the following Immediate Actions for Emergency Boration, identify if the action is required for Unit 1, Unit 2 or both.

a. Place Makeup Mode Select Switch in Manual or Borate position (0.5)

b. Verify V-2525 (load control valve) is closed (0.5)

c. Start either boric acid pump (0.5)

d. Close V-2650 and V-2651 (BAMT Recirc's) (0.5)

e. Note: If VCT level is >5%, V-2501 will not remain closed in the AUTO position unless switch is held to CLOSE. (0.5)

4.13 OP 1-2200050, "Emergency Diesel Periodic Test," Synchronizes a diesel generator with its appropriate 4160V bus, then has the diesel assume some of the electric load on the bus. The operator must verify reactive load is picked up by the diesel. This is done by observing that the varmeter is _____. (1.0)

a. Reading slightly in the "Lead" direction
b. Reading substantially in the "Lead" direction
c. Reading slightly in the "Lag" direction
d. Reading substantially in the "Lag" direction

4.14 Which one of the following is NOT a requirement for increasing RCS pressure greater than 1750 psig on a Unit 2 reactor plant heatup from cold to hot standby? (1.0)

a. Two independent containment spray systems shall be operable with each spray system capable of taking suction from the RWT on a SIAS and automatically transferring suction to the containment sump on a RAS.

b. At least three safety injection tanks operable with each tank containing 74-94% borated water with a concentration between 1720-2100 ppm, having nitrogen cover pressure between 235-650 psig and its isolation valve open.

c. Two independent ECCS subsystems shall be operable consisting of at least one HPSI pump, one LPSI pump and one charging pump.

d. RCS dissolved oxygen concentration shall be <.1ppm.

4.15 Indicate whether the statements below regarding a reactor startup are TRUE or FALSE.

a. If criticality is not achieved by the +500 pcm of ECC value is reached, CEAs should be inserted to the calculated ECC position and start checking the ECC calculation. (0.5)

b. Reed switch position indicators and pulse counting position indication should agree within 4.5 inches on Unit 1 and 5 inches on Unit 2. (0.5)

c. The startup channel detectors on Unit 2 should be switched off at 1000 cps. (0.5)

d. After the CEA shutdown groups are withdrawn fully, then the regulating groups are sequentially withdrawn in the manual sequential mode, observing that the rod bottom lights clear when each regulating group reaches approximately 4 inches. (0.5)

e. Once the reactor is critical, reactor power must be stabilized at 5 x 10^{-4}% in order to record the actual critical conditions. (0.5)

4.16 While operating Unit 1 at full power the differential temperature across the main condenser is observed to be 28°F. Assuming no fouling, maintenance or throttling of the circulating water system, what should be the operator's immediate actions, if any? (Select one) (DELETED) ~~(1.0)~~

a. No immediate actions are required until canal temperature exceeds 115°F or temperature differential exceeds 35°F.

b. The turbine should be shutdown and the reactor placed in hot standby while investigating the cause.

c. If possible, start another circulating pump to increase flow through the condenser and reduce the temperature differential to less than 24°F. Otherwise, reduce turbine load so the

differential is less than 24°F, then investigate the cause.

d. Reduce turbine load until the temperature differential is less than 26°F then investigate the cause.

4.17 When performing a primary system manual calorimetric, a heat balance to determine core thermal power is calculated by figuring the heat inputs and outputs for the primary system. Part of this equation is given below. List the missing inputs/outputs. (2.0)

Q core	+Q _____	+Q _____	+Q _____	+Q _____	
	-Q _____	-Q _____	-Q _____	-Q _____	- L = 0

(L represents RCS Losses)

4.18 The vital loads listed below are not shed and are fed from the emergency buses following a blackout operation. Indicate which unit (or both) they are associated with. (1.0)

a. charging pumps

b. "A" RCP oil lift pumps

c. HVAC valves and dampers

d. Boric acid makeup pumps

e. HPSI pumps

4.19 Indicate whether the statements listed below for a reactor plant cooldown are applicable to Unit 1, Unit 2 or both. (2.0)

a. The shutdown cooling system (SDC) shall not be placed in service until the reactor coolant pressure and temperature are below 265 psia indicated pressurizer pressure and 325°F respectfully.

b. Do not exceed a maximum cooldown of 10°F in any 1-hour period with Tc less than 75°F

c. Before reaching 280°F during cooldown, perform a PORV actuation channel functional test. Do not go below 280°F until both channels are demonstrated operable.

d. When the RCS temperature is less than 500°F and the RCS pressure is less than 1500 psia, rack in the breakers and close the Safety injection Tank discharge valves. When the valves are closed, rack the breakers out.

MASTER

1.0 PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW - ANSWERS

1.01 C. (1.0)

100% Full Power TH = 595°F
TC = 549°F

At 80% ΔT = (.8)(46) = 37°F

Reference: St. Lucie 1&2: "Power Plant Thermodynamics," pgs. 68, 74, 83

1.02 1. T_h has increased (+0.5)

2. steam flowrate has decreased (+0.5)

3. steam temperature has increased (+0.5)

4. steam pressure has increased (+0.5)

Reference: St. Lucie 1&2: "Power Plant Thermodynamics,"pp.68, 74, 83.

1.03 ~~D.~~ C. (1.0)

If the flowrate is reduced, more heat will be added to the coolant as it passes through the core. This will raise the core ΔT. An increase in the temperatures of the core will cause the power produced in the core to try to decrease. However, if the electrical output is to remain the same, the secondary system will adjust and the increase in the core ΔT will remain to offset the decrease in the primary flowrate.

Reference: St. Lucie 1&2: "Power Plant Thermodynamics," pp. 68, 74, 83.

1.04 New boron concentration ≈~~494~~ 439 ppm.

Using Figure A.6

integral worth ARO = 8142 pcm
integral worth 70 in/Bank 7 = 7842 pcm

Hence, the reactivity change due to inserting the rods is 300 pcm (0.5).

Thus, the needed change in the boron concentration is

$$\frac{300}{9.8} = 31 \text{ ppm.} \qquad (+0.5)$$

Using Figure C.2, the initial (critical) boron concentration was ~~525~~ 470 ppm. (0.5)

Therefore, the answer is ~~525~~ 470 - 31 = ~~494~~ 439 ppm. (0.5)

Reference: St. Lucie Unit 1 Curves, Figure A.6, C.1, C.2

1.05 ASI becomes more positive since Bank 7 rods are driven into the core about halfway. The flux would be depressed in the top of the core and since ASI = $\frac{L-U}{L+U}$, it goes positive. (1.0)

Reference: TS Definition 1.23

1.06 b. (1.0)

Reference: CE Steam Tables

Sat. Temp for 2250 psia = 653°F
653°F - 600 = 53°F Subcooling

1.07 a. (DELETED) ~~(1.0)~~

Figure A.1, power defect at 80% of full power = -1500 pcm
power defect at 100% of full power = -2353 pcm.

Hence the reactivity effect due to temperature changes in going from 80% to 100% is 853 pcm.

Reference: St. Lucie 1&2: Unit 1, Plant Curves, Figures 3.1, A.2, A.3, A.4

1.08 b. (1.0)

Reference: St. Lucie 1&2: "Reactor Physics," pp 7.3-24 through 7.3-26

1.09 b. (1.0)

Reference: St. Lucie 1&2, "Reactor Theory" pps 50 (82J8)/d-22 and 23

1.10 1. The deaerating effect of the pressurizer sprays. (.75)

2. The solubility of gases decrease with increasing temperature (.75) and the temperature in the Pressurizer is higher than that of the coolant entering the Pressurizer. (.75)

<u>Reference(s)</u>

1. St. Lucie 1&2: Lesson Plans and System Descriptions, Lecture Outline and Study Guide #1, "Reactor Coolant Gas Vent System."

1.11 a. lower (+0.5)
b. lower (+0.5)
c. lower (+0.5)
d. lower (+0.5)

References: 1. St. Lucie 1&2: St. Lucie Training Documents, "Reactor Physics," Sections 7.5 and 7.7.

1.12 c. (1.0)

Reference: St. Lucie 1&2, "Reactor Physics," pp. 7.5-38 through 7.5-42a

1.13 d. (1.0)

Reference: St. Lucie 1&2, "Reactor Physics," Section 7.5.1.1.1 and 7.5.1.1.2

1.14 c (1.0)

Reference: North Anna FSAR, Table 15.1-5

1.15 c (1.0)

Reference: St. Lucie 1&2, "Reactor Physics" Section 7.3.7

1.16 d (1.0)

Reference: NUS, Nuclear Energy Training Module 3, pg 9.6-1

1.17 a. Larger (0.5)
b. Longer (0.5)
c. Constant (0.5)

Reference: Westinghouse Reactor Physics, Section I-4

1.18 a. True (pg 1.5-3) (0.5)
b. True (pg 1.5-2) (0.5)
c. False (opposite is true pg 1.4-2 and 1.4-4) (0.5)
d. True (CE Stm Tables - Mollier Diagram) (0.5)

Reference: NUS - Plant Performance - pages above

1.19 d. (1.0)

Reference: NUS - Plant Performance - pp 6.2-5 (PD)
6.4-5 (cent.)

1.20 d. (1.0)

Reference: NUS - Plant Performance pp 6.4-5&6

1.21 b. (1.0)

Reference: NUS - Plant Performance, pg 6.5-1 to 6.5-3

1.22 d. (1.0)

Reference: NUS - Plant Performance, pg 3.3-2

1.23 a. (1.0)

Reference: NUS - Plant Performance, pg 9.4-2

1.24 b. (1.0)
(EOL)

Reference: T.S. Basis 3/41-2

1.25 a. (1.0)
(Cold leg Temp)

Reference: T.S.3.2.5

2.0 PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS - ANSWERS

2.01 (c) (1.0)

Reference: SD 111

2.02 (d) (1.0)

Reference: SD 132, page 5

2.03 ~~(c)~~ (DELETED) ~~(1.0)~~

Reference: DC Power System Lecture Notes, pages 1-6.

2.04 (d) or (b) (1.0)

Reference: Lecture Outline 85, page 5.

2.05 (d) (1.0)

Reference: SD 40, pages 22-23

2.06 (a) (1.0)

Reference: SD 123, Rev. 5

2.07 (d) (1.0)

Reference: Lesson Plan #33, pages 2-5

2.08 (c) (1.0)

Reference: SD 130, Revision 0, 12/15.

2.09 (b) (1.0)

Reference: SD 165

2.10 (d) (1.0)

Reference: SD 125

2.11 (a) (1.0)

Reference: Lesson Plan #61

2.12 (b) (1.0)

Reference: SD 9 and Lecture Outline 52 page 9

2.13 (a) (1.0)

Reference: SD-CVCS

2.14 (b) (1.0)

Reference: SD - Containment Spray System

2.15 (a) (1.0)

Reference: Lecture 57, page 1

2.16 (c) (1.0)

Reference: FSAR 1.9B-5

2.17 a. 268 psia (0.5)
325 °F (0.5)

b. Less than (elevation difference) (1.0)

Reference: SD 46 page 1 of 19
SD 38 page 18 of 29

2.18 a. To receive any discharge from the Pressurizer safety and relief valves and thereby "prevent the release...to containment" (0.5)

b. To "collect discharge from miscellaneous reliefs inside containment" (0.5)

Reference: SD 41 page 2 of 18

2.19 (b) (1.0)

Reference: SD 45 page 2 of 12

2.20 (b) (solenoid valve) (1.0)

Reference: SD 46

2.21 ~~(a) There~~ are no automatic controls on plant startup (DELETED) ~~(1.0)~~

Reference: Lecture Outline #95, pp1

2.22 (c) (1.0)

(a) 2 tube bundles - tubes are transverse
(b) 4 minutes at full flow
(d) more tubes towards the center; steam velocity ~ constant

References: SD #123, pp 3-8

2.23 (d) (1.0)

(a) - 2 lines from common header
(b) - it's not supplied in Unit 2
(c) - 200 psig steam

Reference(s): Lecture Outline #63, pp 1-3

2.24 (b) (1.0)

Reference: SD #130, pp 20-21

2.25 (a) (1.0)

Reference: Lecture Outline 93, page 3 of 8

2.26 (c) (DELETED) ~~(1.0)~~

Reference: SD 20, page 3-5

2.27 (d) (1.0)

Reference: CVCS System outline, pp 2

2.28 Answer: (.25 each)

(a) Cooling Water Outlet
(b) Seal Injection Inlet
(c) Control Bleedoff
(d) Cooling Water Inlet
(e) Integral Heat Exchanger
(f) Mechanical Seals
(g) Recirculating Impeller
(h) Auxiliary Impeller

Reference(s): SD #7, Figure 8

3.0 INSTRUMENTS AND CONTROLS - ANSWERS

3.01 a. At -1% the letdown flowrate has decreased to 20 gpm. (0.5)

b. There is no change from -1% to -2%. (0.5)

c. At -3% a backup pump starts. (0.5)

d. At -4% a second backup pump starts (Unit 1 only). (0.5)

e. At -5% a backup signal is generated to start all charging pumps. (0.5)

Reference(s): 1. St. Lucie 1&2: Lesson Plans and System Descriptions #27 (#91), pp. 8 of 11.

3.02 ° TM/LP (.25)

° LPD (.25)

° High SUR (.25)

° Variable high power (.25)

Reference(s): 1. St. Lucie 1&2: Lesson Plans and System Description #29 (#94), "Control Element Drive System (CEDS)," pp. 6 of 14.

3.03 a. The liquid discharge valve is closed (0.5)

b. The blowdown valves and the sample valves are closed (0.5)

c. None (0.5)

d. The surge-tank vent is valved from the ~~drain~~ ATMOS. to the chemical drain tank (0.5)

Reference(s): 1. St. Lucie 1&2: Lesson Plans and System Descriptions #37, "Radiation Monitoring,"

3.04 b or d (1.0)

(a) Regulating and shutdown are reversed
(c) Can only move single CEAs within selected group
(d) No outward motion w/CWP is possible

Reference(s): CEDS lecture outline #94 - pp 7-11

3.05 c (1.0)

Reference(s): Lecture Outline "RPS" Fig. 7.2.21

3.06 c - it uses PZR press, not level as an input (1.0)

Reference(s): SD #15, page 5

3.07 d

(a) uses tref calculator which drops
(b) 5% ramp change
(c) compensated by PER pressure

Reference(s): SD #15 "RRS" pg 9-13

3.08 c or d (1.0)

(a) not a purpose
(b) 56 fixed
(d) 3 - dimensional flux map

Reference(s): SD #35 pp 1-9B-0

3.09 b (1.0)

(a) Correct for Unit 1
(c) ≤600 psia
(d) Correct for Unit 2

Reference(s): 1. Lesson plan #26 "ESFAS"
2. Emergency Op. Proc EOP1-0810040, pp. 6 & 2-0810040 pp.6

3.10 d (1.0)

(a) two out of three - 4th channel is for bypassing
(b) also monitors FW header pressure
(c) components mentioned are controlled by catching relays

Reference(s): SL2 - FSAR - pgs 7.3-15a - 7.3.15d

3.11 b To start 1A1, 1B1 must meet these conditions (1.0)

Reference(s): SD #123, pp 17-24

3.12 d (1.0)

Reference(s): 1. SD #4; pages 37-38

3.13 10^{-8}, 200; 10; 12; 4; 4; 2 BF_3; startup control (.25 each)

Reference(s): 1. SD #4

3.14 b or c (1.0)

(a) emergency stop will not
(c) only initiated locally
(d) 100 RPM, 10 sec.

Reference(s): 1. D-G SD; Control Sequence Engine Control, pg. 3

3.15 d (1.0)

Reference(s): 1. Lecture 52

3.16 b (1.0)

(a) 2-Tc signals, one for each loop
(c) no auctioneering
(d) untrue

Reference(s): 1. Lecture Outline 93; pg 4

3.17 d (steam flow signal only) (1.0)

Reference(s): 1. SD 108-REV.0-20

3.18 c (1.0)

Reference(s): 1. SD 108-REV.0

3.19 c (1.0)

(a) >50% flow
(b) <275, 1 sec
(d) <4 psig

Reference(s): 1. SD-112, pg. 22

3.20 a (1.0)

Reference(s)

1. Lecture Guide #94, page 4

3.21 b (1.0)

Reference(s): System Description #11

3.22 c (1.0)

(a) wrong input
(b) uses different xmtr
(d) feed reg valve is not a FCE.

Reference(s): 1. Lec. Outline #90, page, 2.

3.23 c - it is automatically unblocked as pressure rises (1.0)

Reference(s): ESFAS System Description - pp 7, 9, 19 and Fig. 7.3.5

3.24 b (1.0)

Reference(s): 1. Lecture outline #73

3.25 a, e, b, h, f (.5 each)

Reference(s): SD #7, pp 49-62; SD #8 pp 47

4.0 PROCEDURES: NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL - ANSWERS

4.01 1. the steam supply to the turbine seals

2. air in-leakage to the condenser

3. the status of the Circulating-Water pump

4. the ΔT of the Circulating Water across the condenser

5. the Circulating-Water Box prime

6. the Steam-Jet Air-Ejector (SJAE) operation

7. the SJAE loop seal

8. the condition of Feedwater-Heater alternate-dump valves (0.25 each, 2.0 max)

Reference(s): 1. St. Lucie 1&2: Off-Normal Operating Procedure, 2-0610031, Revision No. 0, "Loss of Condenser Vacuum," Section 5.22, pp. 2 of 3.

4.02 1. All clearances have been properly released. (0.5)

2. All tags have been removed and valves, switches, etc. are in their required positions. (0.5)

3. The system has been tested to the extent that it is evaluated as safe to be returned to service. (0.5)

Reference(s): 1. St. Lucie 1&2: Operating Procedure, 0010122, Revision 21, "In-Plant Equipment Clearance Orders," Section 3.4-3, pp. 2 of 22

4.03 d

Reference: EP No. 2 - 0120041, Rev. 8 pg. 6 of 22

4.04 "...to preheat the auxiliary spray." (1.0)

Reference(s): 1. St. Lucie 1&2: Emergency Operating Procedure, 2-0120040, Revision 4, "Natural Circulation/ Cooldown," Section 5.10-8, pp. 7 of 26.

4.05 An ICRR shall be plotted for the following conditions during approach to criticality:

1. After each refueling (0.5) (see OP-0030221, "Initial Criticality Following Refueling").

2. The conditions used in the ECC calculation are questionable and/or unreliable (0.5) due to a lack of steady operation as determined by the NPS.

3. An excessive reactivity anomaly (0.5), which could affect this approach to criticality, has existed since the last time at which criticality was achieved. An "excessive reactivity anomaly" is defined in Regulatory Guide 1.16 and STS 6.9.1.8.d.

Reference(s): 1. St. Lucie 1&2: Operating Procedure, 2-0030126, Revision 1, "Estimated Critical Conditions and Inverse Count Rate Ratio," pp. 2 of 8.

4.06 d. or c. (1.0)

References(s): 1. St. Lucie 182 Off-Normal Oper. Proc 2-0300031, Rev. 2, Sec. 3.1, pp. 1.

2. Lecture outline 52, pp. 8 - hand written note.

4.07 a. 20°F
b. 30%
c. RCS voids (0.5 each)
d. 40%
e. SDC (shutdown cooling)
f. Nuclear Plant Supervisor/Emergency Coordinator

Reference(s): 1. Off-Normal OP-1-0410030

4.08 c (No chloride monitor listed among symptoms) (1.0)

Reference: OP-1-0610030

4.09 <u>Automatic</u>

1. Runback to 60% on loss of one MFW pump (0.5)

~~2. AFW actuation if SG level <34%~~ ~~(0.5)~~

<u>Immediate</u>

3. Ensure S/G levels can be maintained with available MFW or reduce steam demand until levels can be maintained (0.5)

4. If runback occurs, ensure reactor power is matched with turbine power (0.5)

Reference(s): 1. EP 1-0700040, pg. 3

4.10 c (1.0)

Reference: OP 1-200030

4.11 a. False - both units (0.5)

b. True (0.5)

c. False - 2 valves on Unit 1, 3 valves on Unit 2 (0.5)

d. ~~True~~ FALSE (0.5)

Reference(s): 1. EP 1/2 - 0030140
2. EP 1/2 - 0030141
3. EP 1/2 - 0030143
4. EP 1/2 - 0120043

4.12 a. Unit 2 (0.5)

b. Both (0.5)

c. Both (0.5)

d. ~~Unit 2~~ BOTH (0.5)

e. Unit 2 (0.5)

Reference: OP 1/2 - 0250030

4.13 c (1.0)

Reference(s): OP1-220005, pp4

4.14 b. You need 4 to go over 1750 psig. This is requirement for going above 275 psig. (Note - d is referenced to going >250°F, but you can't go over 1725 psig without Tavg >250°F without exceeding the 350° ΔT limit between the PZR and Tave.

Reference(s): OP2-0030121 pp 1-5

4.15 (a) False (10 - 500WPCM) (b) True (c) False (2000 CPS)
(d) False - withdraw each group in manual group to 4" then go manual sequential (.5 each)
(e) True

Reference: 1/2-0030122 "Reactor Startup"

4.16 ~~(d)~~ (DELETED) ~~(1.0)~~

Reference: Off normal procedure 0620030, pgs 1-3

.25

4.17 Inputs: FW (feedwater) (.8 each)
RCP (Reactor Coolant Pumps)
Ch (Charging)
PZR (Pressurizer)

Outputs: CCW (Component Cooling Water)
Steam (Steam Flow)
Bd (Blowdown)
Ld (Letdown)

Reference: OP 1-3200020 pp 3/4

4.18 (a) Unit 1 (.2 each)
(b) Both
(c) Unit 2
(d) Unit 1
(e) Both

Reference(s): EP-1-0030140 pp 3
EP-2-0030140 pp 3

4.19 (a) Unit 1 (pp1) (b) Unit 2 (pp(1)) (.5 each)
(c) Unit 2 (pp5) (d) Unit 1 (pp7)

Reference(s): OP 1/2-0030127