ENCLOSURE 1

EXAMINATION REPORT - 50-335/OL-85-02

Facility Licensee: Florida Power and Light Company
P. O. Box 14000
Juno Beach, FL 33408

Facility Name: St. Lucie

Facility Docket No. 50-335

Written examinations were administered at St. Lucie EOF near Ft. Pierce, Florida. Oral examinations were administered at St. Lucie Station near Juno Beach, Florida.

Chief Examiner: Sandy Lawyer — 3/3/86
Sandy Lawyer — Date Signed

Approved by: Bruce A. Wilson — 3/11/86
Bruce A. Wilson, Section Chief — Date Signed

Summary:

Examinations on December 16-20, 1985

Oral examinations were administered to 16 candidates; all of whom passed. Written examinations were administered to 15 candidates, 14 of whom passed.

REPORT DETAILS

1. Facility Employees Contacted:

*M. D. Shepherd, Florida Power and Light (FP&L) OPS Training Supervisor
*J. Charles Couture, FP&L Hot License Program
*R. Weller, FP&L Licensing Training Coordinator
*J. Barrow, FP&L Operations Superintendent
*K. Harris, FP&L Site Vice President
*D. Sager, FP&L Plant Manager

*Attended Exit Meeting

2. Examiners:

W. G. Douglas, NRC Examiner
*L. L. Lawyer, NRC Examiner
R. V. Crlenjak, NRC Senior Resident Inspector (SRI)
J. Upton, PNL
R. Clark, PNL
J. D. Smith, PNL

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners provided M. D. Shepherd, with a copy of the written examination and answer key for review. Utility comments on the written examination are attached as Enclosure 4 to this report. The following resolutions are provided to these comments.

a. SRO Exam

(1) Question 5.07b

NRC Resolution: The answer key was changed to reflect an acceptable range of 2800 pcm to 4300 pcm.

(2) Question 5.07d

NRC Resolution: Use of the plant curves does show that peak xenon cannot be overcome. Question 5.07d was deleted.

(3) Question 5.11

NRC Resolution: Typographical errors in the answer key to parts a, b and d were corrected prior to grading. Part c was graded using the candidate's answer from part a and a range of values for B of 0.005 to 0.007 were accepted. In part d, POAH was not deemed

as an acceptable answer since the question clearly asked for a specific power level in percent.

(4) Question 5.12

NRC Resolution: Calculational errors in the answer key were corrected, the total point value for part b was reduced to 1.0 and either the ratio 1.05 or keff of 0.9238 were accepted for full credit.

(5) Question 6.04

NRC Resolution: Either answer c or d was accepted.

(6) Question 6.08a

NRC Resolution: The three means of protection as stated in the reference are turbine trip, turbine runback, and overspeed protection. The DEH turbine trips include loss-of-DC-power and electrical overspeed. The overspeed protection circuit includes the LDA and CIV. Any combination of "overspeed protection", "LDA", or "CIV" was accepted for 0.5. Any combination of "turbine trips", "loss-of-DEH-power", and "electrical overspeed" was accepted for 0.5.

(7) Question 6.08b

NRC Resolution: The answer key was changed to reflect the two additional answers "differential expansion" and "bearing temperature".

(8) Question 6.13d and 6.14c

NRC Resolution: The answer key was changed to indicate that "Units 1 and 2" is the correct answer.

(9) Question 6.14e

NRC Resolution: On page SD24-Rev. 1-38 it is stated, "to ensure that boric acid does not precipitate, hot-leg injection is established within 10 hours... ." In Unit 2, the LPSI pumps cannot be used for hot-leg injection. Therefore, the correct answer is Unit 1.

(10) Question 6.15b

NRC Resolution: Either 1 hour or 1 day were accepted as the correct answer.

(11) Question 7.10

NRC Resolution: The question was deleted.

(12) Question 7.17

NRC Resolution: Phraseology which states that the evolution should be terminated will be accepted.

(13) Question 8.12b

NRC Resolution: Rapid RCS cooldown would not cause gases to come out of solution AND the primary source of gas would be the RCS flashing to steam. Steam is a gas, although not a non-condensible gas. No change in the answer key is warranted.

(14) Question 8.14

NRC Resolution: The question was deleted.

(15) Question 8.17

NRC Resolution: Specifying the values of the temperature entry conditions was not a required part of the answer. No change required.

(16) Question 8.18b

NRC Resolution: The answer key was changed to reflect the addition of 88% as an acceptable answer.

b. RO Exam

(1) Question 1.07d

NRC Resolution: Same as question 5.07b.

(2) Question 1.15a

NRC Resolution: The answer key was corrected to indicate a range of 850-970 psia.

(3) Question 2.02

NRC Resolution: Same as question 6.04.

(4) Question 2.06

NRC Resolution: The answer key was changed to reflect that either 1 or 4 was a correct answer.

(5) Question 2.08

NRC Resolution: The answer key was corrected to indicate Units 1 and 2 as the correct answer to part e.

(6) Question 2.09d

NRC Resolution: Same as 6.14c.

(7) Question 2.09f

NRC Resolution: Same as 6.14e.

(8) Question 2.10a and b

NRC Resolution: The answer key was changed to include "8 and 11 open" in a and "13, 14 open; 1, 2 close" in b.

(9) Question 2.10c

NRC Resolution: The need to provide the dynamic head in ft. was deleted and the point value of the remaining parts were changed accordingly.

(10) Question 2.10d

NRC Resolution: Same as 6.15b.

(11) Question 2.12b

NRC Resolution: The question was changed during the examination to require those components that are on the N-header at both units. The answer key was changed to reflect this.

(12) Question 3.03

NRC Resolution: The answer key was changed to show the correct answer a.

(13) Question 3.04

NRC Resolution: The answer key was changed to reflect that both c and d are correct answers.

(14) Question 3.05a

NRC Resolution: In addition to the design pressure answer of 56 ± 11 psig, an answer of 40 to 50 psig will be acceptable, thereby including the operating pressure.

(15) Question 3.05b

NRC Resolution: The range for an acceptable answer will be 10 to 40 seconds.

(16) Question 3.06

NRC Resolution: The answer key will be modified to accept as an alternate answer the results of the recent plant changes in Unit 1. The alternate answer set will be:

200
12
14
6
6

fission chamber
4 or all
fission
startup
BF_3

(17) Question 3.11a-e

NRC Resolution: Based on the instructions given during the examination, the answer key was modified as indicated by the Facility Comments.

(18) Question 3.13b

NRC Resolution: The correct answer is "True". The answer key was changed accordingly.

(19) Question 4.15

NRC Resolution: The question has been modified to require any 5 of the 8. Point values were modified appropriately.

4. Exit Meeting

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

There were no generic weaknesses noted during the oral examination.

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

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

ENCLOSURE 3

U.S. NUCLEAR REGULATORY COMMISSION

SENIOR REACTOR OPERATOR LICENSE EXAMINATION

master

Facility: St. Lucie 1 & 2 (50-335 & 389)

Reactor Type: PWR-CE

Date Administered: December 16, 1985

Examiner: Joe Upton

Candidate: Answer Key

INSTRUCTIONS TO CANDIDATE:

Print your name on the line above marked "Candidate." The grade points available for each question are indicated within parentheses after each question. The passing grade is 70% in each of the four (4) categories and is 80% for the total grade. Use separate paper for your answers and write on only one (1) side of the paper, unless a specific question instructs you otherwise. Staple this question package to your answer sheets. 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. When you have finished this examination, affirm the statement by signing your name.

Category Value	% of Total	Candidate's Score	% of Cat. Value	Category
~~30~~ 27.5	~~25~~			5. Theory of Nuclear Power Plant Operation, Fluids and Thermodynamics
30	25			6. Plant System Design, Control, and Instrumentation
~~30~~ 29.5	25			7. Procedures - Normal, Abnormal, Emergency, and Radiological Control
~~30~~ 29.5	25			8. Administrative Conditions, Procedures, and Limitations
~~120~~ 116.5 BW				TOTALS

Final Grade _____ %

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

_____

Candidate's Signature

FURTHER INSTRUCTIONS TO CANDIDATE

1. At the end of the written examination package is a copy of Figures A.1 through A.8 taken from the Unit 1 Plant Physics Curve Book. Use them as appropriate.

2. At the end of the written examination package is a reference page containing equations, formulas, and constants. Use them as necessary.

3. Use the "Steam Tables" as necessary.

Points
Available

5.0 THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS AND THERMODYNAMICS (30.0)

QUESTIONS 5.01 through 5.05 are "multiple-choice" questions.

QUESTION 5.01

A tank contains water to a level of 40 ft above the bottom of the tank. A nitrogen cover gas is at 100 psia. The tank and its contents are at 70°F and the density of the water is 62.4 lbm/ft^3. The pressure at the bottom of the tank is (1.0)

(a.) 117 psig

(b.) 117 psia

(c.) 83 psig

(d.) 83 psia

ANSWER 5.01

(b.) **(+1.0)**

Reference(s) 5.01

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 3-11.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.02

If the temperature of the tank in QUESTION 5.01 (container, water and cover gas) were raised and if no water or cover gas was allowed to enter or leave the tank, the pressure at the bottom of the tank would (1.0)

(a.) increase because the water level would rise and the temperature of the gas has increased.

(b.) increase because the pressure due to the water would rise and the temperature of the gas has increased.

(c.) decrease because the water density has decreased.

(d.) decrease because the cover-gas density has decreased.

ANSWER 5.02

(a.) **(+1.0)**

Reference(s) 5.02

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 3-11, 38-40.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.03

The nuclear reactor at St. Lucie Unit 1 is called a "thermal reactor" because (1.0)

(a.) the reactor produces thermal energy as a result of the energy released by a fission process which, on the average, produces above 200 MeV per fission event.

(b.) the thermal power produced by the reactor is readily controlled due to the presence of delayed neutrons which have a lower average energy than fission neutrons

(c.) on the average, the neutrons produced by the fissioning process are at an energy level that corresponds to the temperature of the surrounding materials.

(d.) on the average, the neutrons causing fission are at an energy level that corresponds to the temperature of the surrounding materials.

ANSWER 5.03

(d.) **(+1.0)**

Reference(s) 5.03

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, p. 7.1-2.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.04

The isotope of plutonium, Pu^{239}, can be found in the nuclear-reactor core of St. Lucie Unit 1 because (1.0)

(a.) of the Doppler-broadening of neutron-absorption peaks for U^{235} nuclei.

(b.) of the non-fission absorption of a thermal or epithermal neutron by U^{238} nuclei.

(c.) of the fissioning of U^{238} nuclei by fast neutrons.

(d.) of the non-fission absorption of a thermal neutron by U^{235} nuclei.

ANSWER 5.04

(b.) **(+1.0)**

Reference(s) 5.04

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, pp. 7.3-10, 7.3-11, 7.3-24.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.05

The moderator temperature coefficient (MTC) increases with temperature in the core of the Unit 1 power plant because (1.0)

(a.) with increasing temperature the void fraction increases.

(b.) the decrease in the water density for an increase in temperature increases with temperature.

(c.) the water density decreases with an increase in temperature.

(d.) the decrease in the water density for an increase in temperature decreases the amount of boron in the core.

ANSWER 5.05

(b.) **(+1.0)**

Reference(s) 5.05

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, p. 7.5-27.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.06

Referring to Figure 5.06 (QUESTION), answer the following parts to this QUESTION by choosing the correct response or by "filling-in the blanks". The pump has been operating at 1/2 of its rated capacity.

a. Assume that the filter has become "plugged-up" to a greater degree. How does the difference in the water heights in the local indicator (manometer) change? (INCREASE, DECREASE, or STAY-THE-SAME) (0.5)

b. With this change in the filter, how does the flowrate of the water change? (INCREASE, DECREASE, or STAY-THE-SAME) (0.5)

c. Assume that the filter's characteristics did not change, but that the throttling-valve position has been changed to reduce the flowrate by a factor of 2. The difference in the water heights in the local indicator (manometer) would _____ (INCREASE, DECREASE, or STAY-THE-SAME) by a factor of _____. (1.0)

d. With this change in the throttling-valve position, the differential pressure across the valve would _____ (INCREASE, DECREASE or STAY-THE-SAME) by a factor of _____. (1.0)

ANSWER 5.06

a. INCREASE (+0.5)

b. DECREASE (+0.5)

c. DECREASE (+0.5)
4 (+0.5)

d. INCREASE (+0.5)
4 (+0.5)

Reference(s) 5.06

1. Generic: Academic Program for Nuclear Power Plant Personnel, Volume III, Nuclear Power Plant Technology, 1973, General Physics Corporation, pp. 2-127 - 2-132.

-Section 5.0 Continued on Next Page-

Points
Available

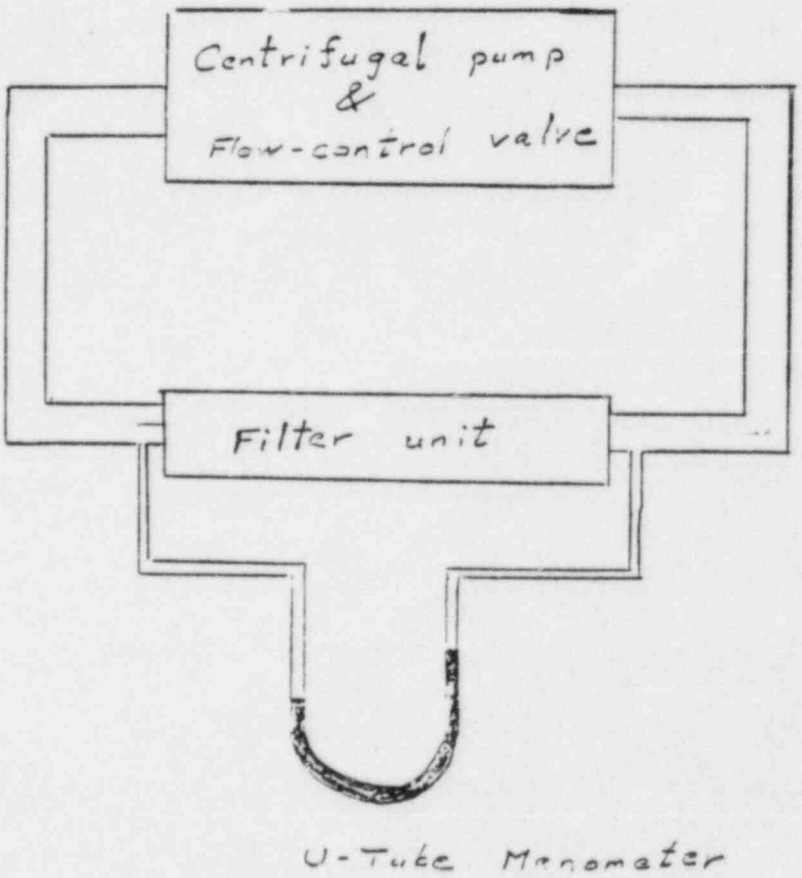

Figure 5.06 (QUESTION)

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.07

Answer the following parts of this QUESTION concerning the operation of the St. Lucie Unit 1 power plant on Cycle 6 with 12,075 EFPH.

a. If the plant had been operating at 100% of full power for 17-1/2 hours (The plant had been in HOT-STANDBY for 15 days before commencing FULL-POWER operation.), the magnitude of the xenon worth would be _____ ppm (± 100 pcm). (0.5)

b. If the plant tripped while in the condition of part "a", the magnitude of the peak xenon worth would be _____ ppm (± 400 pcm). (0.5)

c. When, in part "a.", the power level dropped, the initial changes resulted in the "burnup" of the Xe^{135} being _____ (INCREASED, STAYED-THE-SAME or DECREASED) while the production of Te^{135}/I^{135} _____ (INCREASED, STAYED-THE-SAME, or DECREASED) and while the rate-of-decay I^{135} _____ (INCREASED, STAYED-THE-SAME, or DECREASED). (1.5)

~~d. If the plant tripped from a condition of "equilibrium xenon" from 100% of full power, the plant curves indicate that the plant would be able to overcome peak xenon by _____ pcm (± 10%). Neglect any change in the boron concentration. (1.5)~~ delete BW

ANSWER 5.07

a. 2100 ± 100 pcm (+0.5)

b. ~~3300 ± 400 pcm~~ 2900 to 4300 (+0.5)

c. DECREASED (+0.5)
DECREASED (+0.5)
STAYED-THE-SAME (+0.5)

~~d. 218 pcm ± 22 pcm (+1.5)~~ delete 5

-Section 5.0 Continued on Next Page-

Points
Available

Reference(s) 5.07

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, pp. 7.5-6 - 7.5-15.

2. St. Lucie: Administrative Procedures, 0010140, Revision 1, Control of Operator Aids, Attachment (3), Plant Physics Curve Book, Figure A.1, A.2, A.3, A.4, A.6.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.08

Answer the following parts of this QUESTION using Figure A.5 of the Plant Physics Curve Book for St. Lucie Unit 1 on Cycle 6, as appropriate.

a. If the Unit 1 power plant had been operating continuously at 100% of full power for 400 hours, what would be the magnitude of the reactivity worth for samarium and neptunium? (0.5)

b. If the Unit 1 power plant had been operating continuously at 50% of full power for 400 hours, what would be the magnitude of the reacitivity worth for samarium and neptunium? (0.5)

c. If, after this 400-hour run at 50% of full power, the Unit 1 power plant had tripped, what would be the magnitude of the reactivity worth for samarium and neptunium toward which the core would trend? (0.5)

ANSWER 5.08

a. 650 pcm ± 5 pcm **(+0.5)**

b. 650 pcm ± 5 pcm **(+0.5)**

c. 700 pcm ± 40 pcm **(+0.5)**

Reference(s) 5.08

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, pp. 7.5-16 - 7.5-18.

2. St. Lucie: Administrative Procedures, 0010140, Revision 1, Control of Operator Aids, Attachment (3), Plant Physics Curve Book, Figure A.5.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.09

Answer with TRUE or FALSE to each statement given below concerning subcritical operation of Unit 2 in Cycle 2.

a. If the reactor had been shutdown for 3 months, the source-range instruments would loose their ability to determine the level of the neutron flux because the flux level would be too low. (0.5)

b. The neutron flux level is determined primarily by the neutrons produced by the intrinsic sources, the largest of which is due to α-particle absorption in O^{18}. (0.5)

c. If the indicated count-rate by the source-range instruments doubled, the reactivity margin (to criticality) has been reduced by one-half. (0.5)

d. For each equal insertion (addition) of reactivity, it takes a longer amount of time for an equilibrium neutron-flux level to be reached as k_{eff} approaches unity. (0.5)

e. If 10 inches of CEA withdrawal increased the count-rate by a source range instrument by 10 cps, then 20 inches of CEA withdrawal would have increased the count-rate by 20 cps. (0.5)

ANSWER 5.09

a. FALSE (+0.5)

b. FALSE (+0.5)

c. TRUE (+0.5)

d. TRUE (+0.5)

e. FALSE (+0.5)

-Section 5.0 Continued on Next Page-

Points
Available

Reference(s) 5.C9

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, Section 7.7.2.

2. Generic: Nuclear Energy Training, Volume 3, Reactor Operations, Unit 12, pp. 12.1-1 ff.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.10

Answer the following parts of this QUESTION by listing the answer or by "filling-in tne blanks."

The heat transfer in the Steam Generators at St. Lucie involves a combination of both conduction and convection. The following equation for the combined (overall) heat transfer coefficient in (Btu/hr-ft^2-^{o}F) is typically used to describe this heat transfer.

$$U_o = \frac{1}{1/h_1 + \Delta r/k + 1/h_2}$$

a. If U_o is known for a Steam Generator, what other data besides U_o must be known to calculate the rate of heat transfer (in Btu/hr) from primary coolant to the secondary water/steam? (1.0)

b. Consider two (2) Steam Generators; one is clean and new and one has heavy mineral deposits on the outer surfaces of the tubes. If the temperatures of the RC and the feedwater/steam are the same for both Steam Generators, then the rate of heat transfer (in Btu/hr) in the fouled-tube Steam Generator is _____ because the overall heat-transfer coefficient is _____ which could be represented by a _____ k. Answer SMALLER or LARGER for each blank. (1.5)

ANSWER 5.10

a. overall ~~cross-sectional~~ SURFACE area for heat transfer
overall temperature difference **(+0.5 each)**

b. SMALLER
SMALLER
SMALLER

(+0.5 each)

-Section 5.0 Continued on Next Page-

Points
Available

Reference(s) 5.10

1. St. Lucie: Reactor Physics Training Manual, Heat Transfer, pp. 2-151 - 2-155.

QUESTION 5.11

At Unit 1, the neutron multiplication factor, k_{eff}, just changed from 0.920 to 1.004. Assume that this was a very quick change, a jump change in reactivity. Answer the following parts of this QUESTION by "filling-in the blanks".

a. The reactivity of the core is now _____ pcm. (0.75)

b. The change in reactivity required in going from 0.920 to 1.004 was _____ pcm. (0.75)

c. Immediately after the jump change in reactivity, the reactor period would be _____ seconds. (1.0)

d. The reactor would approach a constant power level of _____ %. (1.0)

ANSWER 5.11

a. ~~39.8 ± 0.2~~ pcm **(+0.75)**

b. ~~39.8~~ + ~~869.6~~ = ~~909.4~~
~~909.4 ± 10~~ pcm **(+0.75)**

c. 7.6 ± 1.0 seconds **(+1.0)**

d. ~~2.5~~ ± 1% power **(+1.0)**

Reference(s) 5.11

1. St. Lucie: Reactor Physics Training Document, Reactor Physics, pp. 7.5-1 - 7.5-2, 7.6-16 - 7.6-20.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.12

Assume that the neutron multiplication factor, k_{eff}, is 0.92 for the Unit 1 core and the source strength is 1.0×10^5 neutrons per generation.

a. What is the neutron population (neutrons per generation) in the core? (1.0)

b. If the control-rod worth for a given rod was a constant 10 pcm/in. and if the rod was withdrawn 45 in., by what multiplication factor would the neutron population increase? (1.0)

ANSWER 5.12

a. $$\frac{S_o}{1 - k_{eff}} = \frac{10^5}{1 - 0.92} \quad (+0.5)$$

$$= 1.25 \times 10^6 \quad (+0.5)$$

b. (869.6 pcm) - (10 pcm/in. 45 in.) = ~~419.6~~ 869.6 - 450 = 419.6 pcm ~~(+0.5)~~

$$\frac{1 - k}{k} = \frac{0.00825}{419.6} \quad (+0.5)$$

$$k = \frac{0.9238}{0.96} \quad (+0.5)$$

$$N_2/N_1 = \frac{0.08}{0.04} = \frac{1.05}{2} \quad (+0.5)$$

(1.0 Total Pts)

Reference(s) 5.12

1. St. Lucie: Reactor Physics Training Document, Reactor Physics, pp. 7.7-3 - 7.7-8.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.13

Answer this QUESTION by "filling-in the blanks" with -4, -3, -2, -1, 0, +1, +2, +3, or +4.

When an element absorbs a neutron and emits an α-particle, the new element will have an atomic number that is _____ and a mass number that is _____ compared to the original element. (1.0)

For example, an answer of -2 means that the new element has an atomic/mass number that is 2 less than that of the original element; an answer of 0 means that there is no change in the atomic/mass number.

ANSWER 5.13

-2

-3

(+0.5 each)

Reference(s) 5.13

1. Generic: Academic Program for Nuclear Power Plant Personnel, Volume II, Physics, General Physics Corporation, pp. 3-16 - 3-19, 3-47 - 3-49.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.14

a. With the steam in the Steam Generator at 540°F and the ~~temperature~~ pressure leaving the high-pressure turbine at 300 psia, what is the %-moisture of the steam entering the MSR? (1.0)

b. If your answer to part "a" was 19%, what is the quality of the steam entering the MSR? (1.0)

ANSWER 5.14

a. find the intersection of 540°F and the saturation curve; assume a isentropic process; answer = 12 ± 1% **(+1.0)**

b. %-quality = 100 - %-moisture
= 100 - 19
= 81% **(+1.0)**

Reference(s) 5.14

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 18, 30-31.

-Section 5.0 Continued on Next Page-

Points
Available

QUESTION 5.15

A rupture of a Main-Steam line is a more severe incident (a more limiting condition) at EOC than at BOC. Briefly explain. (2.0)

ANSWER 5.15

The MTC is less negative at BOC than at EOC **(+0.67)**. This difference increases the severity of the incident at EOC because the incident provides a sudden cooling of the RCS **(+0.67)** which via the MTC causes the reactivity of the core to increase **(+0.67)**.

Reference(s) 5.15

1. Generic: Academic Program for Nuclear Power Plant Personnel, Volume III, Nuclear Power Plant Technology, 1973, General Physics Corporation, pp. 2-127 - 2-132.

-End of Section 5-

Points
Available

6.0 PLANT SYSTEM DESIGN, CONTROL, AND INSTRUMENTATION (30.0)

QUESTIONS 6.01 through 6.06 are "multiple-choice" questions.

QUESTION 6.01

The Reactor Cavity Cooling System consists of two (2) full capacity fans with the fan that is (1.0)

(a.) in standby started automatically; if the reactor-cavity ambient temperature, as measured by either of the two (2) TCs located near the excore neutron detectors, alarms at 150°F.

(b.) in standby started automatically on a CIAS.

(c.) in standby started automatically after a 10-second delay on LO flow in the operating fan.

(d.) in operation restarted automatically after a loss of off-site power as demanded by the D/G shutdown sequencer.

ANSWER 6.01

(d.) **(+1.0)**

Reference(s) 6.01

1. St. Lucie: Primary Systems, Book 1, Training Department, Reactor Vessel and Internals, Fuel, and Reactor Core, pp. SD2-Rev. 1-7 - 1-8.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.02

During Mode 1 operation with all systems/components operable and aligned in the normal manner, the four (4) motor-operated isolation valves for the Safety Injection Tanks (SITs) are (1.0)

(a.) CLOSED to isolate the SITs from the RCS but receive an OPEN signal on a SIAS.

(b.) interlocked with Pressurizer pressure such that, if the RCS pressure is ≥ 350 psia at Unit 1, the valves would be automatically CLOSED.

(c.) interlocked with Pressurizer pressure such that, if the RCS pressure ≥ 350 psia at Unit 2, any valve that is not fully CLOSED would annuciate an alarm in the control room on R-39.

(d.) operated by motors which are powered individually from buses A5, A6, B5, and B6.

ANSWER 6.02

(d.) **(+1.0)**

Reference(s) 6.02

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Removal System, SD24-Rev. 1-18 - 1-20.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.03

The Pressurizer-System design is intended to (1.0)

(a.) compensate for volume changes in the RCS for design transients of a 10% power/min ramp or a 5% power step.

(b.) provide sufficient steam volume to prevent the water level from reaching the relief-valve nozzles following a reactor trip.

(c.) provide a small enough water volume to minimize the pressure buildup in the containment following a LOCA.

(d.) provide sufficient water level to prevent draining the Pressurizer following a load-reject incident.

ANSWER 6.03

(c.) **(+1.0)**

Reference(6.03)

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 1 of 2, Section 1, 1982, p. i.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.04

The Shutdown Cooling (SDC) heat exchangers are used to remove heat during cooldown (1.0)

(a.) if the pressure is ≤ 1500 psia and the temperature is ≤ 500°F.

(b.) if the CCW inlet temperature is ≤ 55°F.

(c.) with the cooldown rate controlled by throttling the SDC return valves to the LPSI headers.

(d.) with the cooldown rate controlled by throttling the LPSI flow-control valves which are in parallel with the SDC heat exchangers.

ANSWER 6.04

(c.) (+1.0) or (d.)

Reference(s) 6.04

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Removal System, pp. SD24-Rev. 1-20.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.05

The A and B trains of the 125 VDC System are normally lined-up such that (1.0)

(a.) the C train is powered from either of the A or B buses via the swing bus AB in Unit 2.

(b.) the swing bus AB is powered from the A-side train in Unit 1.

(c.) the battery charger AB is connected to the A-side train in Unit 2.

(d.) the swing bus AB is powered from the A-side train in Unit 2.

ANSWER 6.05

(d.) **(+1.0)**

Reference(s) 6.05

1. St. Lucie: Electrical Systems, Book 7, Training Department, 120 VAC Instrument and 125 VDC Distribution System, p. SD145-Rev. 0-7 and Figure 1.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.06

The blowdown line of Steam Generator (S/G) 1A has (1.0)

(a.) an air-actuated containment-isolation valve inside containment which is CLOSED by a CIAS or by a blowdown HI-radiation control signal.

(b.) a temperature-measuring element downstream of the containment isolation valve which can provide information to determine S/G temperatures for RCP starting requirements.

(c.) a flowrate sensor which controls the pressure-control valve located just upstream of the flowrate sensor.

(d.) a flowrate sensor which controls both the inside and outside of containment isolation valves to provide protection in the event of a high-energy line break.

ANSWER 6.06

(b.) **(+1.0)**

Reference(s) 6.06

1. St. Lucie: Secondary Systems, Book 4, Training Department, Steam Generator Blowdown, pp. SD102-Rev. 1-6 - 1-9.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.07

Refer to Figure 6.07 (QUESTION) which shows a typical level-measuring system for such closed tanks as the Pressurizer and the Steam Generator. Answer the following parts to this QUESTION by choosing the correct response, by "filling-in the blanks", or by completing the sentence.

a. The output of the D/P cell is $P_R - P_V$. This output is equal to the water density times _____ (h_1, h_2, h_3, h_4, or h_5). (0.5)

b. If the reference leg broke and some of the water in the reference leg drained out, the output of the D/P cell, ($P_R - P_V$), would _____ (INCREASE, DECREASE, or STAY-THE-SAME) and the indicated level would _____ (INCREASE, DECREASE, or STAY-THE-SAME). (1.0)

c. If there were a power-plant transient which quickly reduced the pressure in the tank, the water level in the reference leg would _____ (INCREASE, DECREASE) due to _____ _____. (1.0)

d. Increasing containment temperature from a line break (not from the tank or its level-measuring system) would cause the indicated tank level to _____. (INCREASE DECREASE, or STAY-THE-SAME) (0.5)

ANSWER 6.07

a. h_2 **(+0.5)**

b. DECREASE **(+0.5)**
INCREASE **(+0.5)**

c. DECREASE **(+0.5)**

reference-leg water flashing to steam and flowing out of the condensing pot **(+0.5)**

-Section 6.0 Continued on Next Page-

Points
Available

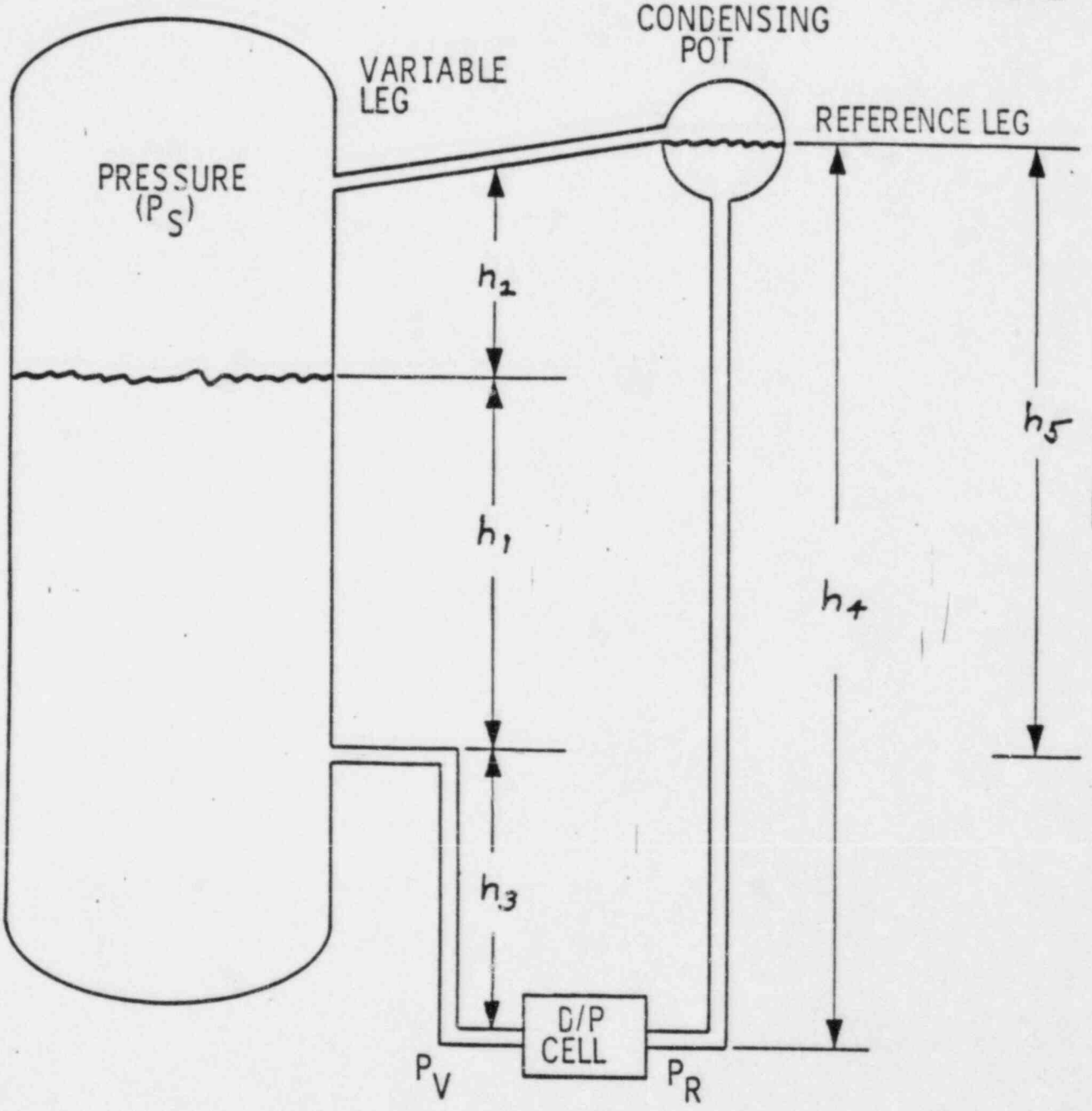

Figure 6.07 (QUESTION)

-Section 6.0 Continued on Next Page-

Points
Available

ANSWER 6.07 (cont)

d. INCREASE **(+0.5)**

Reference(s) 6.07

1. Generic: C-E Training Document, Controllers and Process Instrumentation, pp. 969(82W3)/ds-29 - 30.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.08

Answer the following parts of this QUESTION concerning the operation and control of the Main Turbine by listing the answers or by "filling-in the blanks".

a. The EH Control System provides the Turbine with three (3) means of protection: _____ _____. (1.5)

b. During operation, the Turbine is monitored by the turbine supervisory instruments for proper operation. The turbine supervisory instruments consist of detectors for (2.0)

1. rotor position
2. _____
3. _____
4. _____
5. _____

ANSWER 6.08

(or loss of DEH power, electrical overspeed)

a. turbine runback, turbine trip and overspeed protection (or LDA or CIV) **(+0.5 each)**

b. 1. rotor position
2. vibration
3. eccentricity
4. casing expansion
5. speed

6. differential expansion
7. bearing temperature

(+0.5 each for 2 through ~~5~~ 7)

Reference(s) 6.08

1. St. Lucie: Secondary Systems, Book ~~8~~ 6, Training Department, DEH Control System, pp. SD127-Rev. 0-7 - 0-8.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.09

Answer the following parts of this QUESTION, all of which pertain to the Qualified Safety Parameter Display System (QSPDS).

a. The instrument sensor package for Inadequate Core Cooling (ICC) detection provides the reactor operator a continuous indication of the progression leading to and away from ICC. The progression is divided into three (3) conditions based on physical processes occurring within the reactor vessel. The three (3) conditions are

falling coolant inventory
loss of fluid subcooling
increasing core-exit temperature

Place a #1 next to the condition that is least severe. Place a #3 next to the condition that is the most severe, that is of greatest concern. (1.0)

b. Figure 6.09 (QUESTION) is a sketch of a HJTC used in the QSPDS. With the use of the figure, provide a brief indication of the operational principle of an HJTC in detecting a decreasing water level. (1.0)

c. The QSPDS determines three (3) Saturation Margin Monitoring (SMM) values. List the three (3) margins and the associated temperature sensors that are utilized. (1.5)

d. What signal is used to provide the saturation temperature? (0.5)

ANSWER 6.09

a. loss of fluid subcooling #1
falling coolant inventory
increasing core-exit temperature #3

(+1.0)

-Section 6.0 Continued on Next Page-

Points
Available

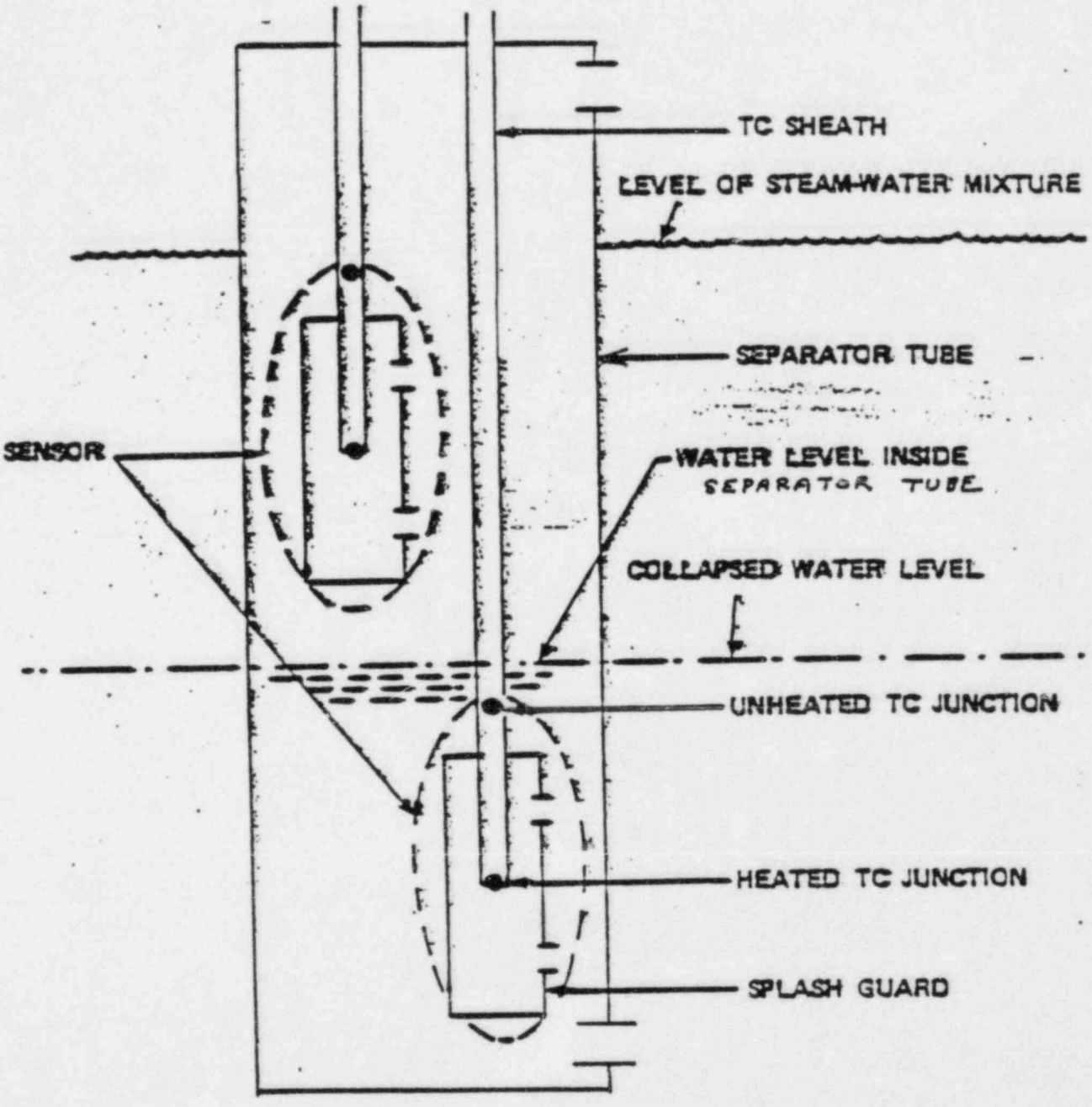

Figure 6.09 (QUESTION)

-Section 6.0 Continued on Next Page-

Points
Available

ANSWER 6.09 (cont)

b. The sensor consists of two (2) TCs one of which is heated. If the heated TC is in water, the heat is sufficiently dissipated that the two (2) TCs have equal outputs; if not, there is a difference in outputs. So when the calm water level drops below the heated TC level, the HJTC provides an indication. **(+1.0)**

c. RCS saturation margin - max of RTDs in the hot and cold legs. **(+0.5)**

upper-head saturation margin - max of the top three (3) UHJTCs **(+0.5)**

CET saturation margin - max CET **(+0.5)**

d. Pressurizer pressure **(+0.5)**

Reference(s) 6.09

1. St. Lucie: Control Systems, Book 5, Training Department, Computer Monitoring Systems QSPDS Handout, pp. 1-18.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.10

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, if any, in the letdown flowrate should occur and/or what alarms and actions, if any, should be taken by the CVCS as the Pressurizer level slowly decreases to the levels indicated below? Include any differences between Units 1 and 2.

a. -1% (0.5)

b. -2% (0.5)

c. -3% (0.5)

d. -4% (0.5)

e. -5% (0.5)

ANSWER 6.10

a. At -1% the letdown flowrate should have decreased to almost 29 gpm. **(+0.5)**

b. There is no change between -1% and -2%. **(+0.5)**

c. At -3% (at -2.5%) a backup charging pump should have started. **(+0.5)**

d. By -4% a second backup charging pump should have started at Unit 1, but not at Unit 2. **(+0.5)**

e. At -5% a LO-level alarm occurs and backup START signal should be sent to all of the charging pumps. **(+0.5)**

Reference(s) 6.10

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 2 of 2, Section 27, 1982, p. 8 of 11.

2. St. Lucie: Secondary Systems, Book 5, Training Department, Reactor Regulating System, pp. SD9-Rev.1-55 and Figure 34.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.11

List the four (4) Reactor Protection System (RPS) pre-trips that should prevent the withdrawal of a Control Element Assembly (CEA) with the CEDS in any control mode. (2.0)

ANSWER 6.11

TM/LP
LPD
HI SUR
variable high power

(+0.5 each)

Reference(s) 6.11

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 2 of 2, Section 27, 1982, p. 6 of 14.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.12

Answer the parts of this QUESTION concerning the Containment Cooling System by "filling-in the blanks".

a. Upon the receipt of a SIAS, _____ (1, 2, 3, or 4) containment-cooling fans should START in _____ (SLOW, FAST, or NORMAL) speed at Unit 1 while _____ (1, 2, 3, or 4) containment-cooling fans should START in _____ (SLOW, FAST, or NORMAL) speed at Unit 2. (1.0)

b. Water from the _____ System is supplied to the cooling coils of the containment-cooling fan coolers through motor-operated supply and return valves which should _____ (OPEN, CLOSE, or STAY-THE-SAME) on a CIS. At Unit 1 there are _____ motor-operated supply valves while at Unit 2 there are _____. (1.0)

ANSWER 6.12

a. 4
NORMAL
4
SLOW

(+0.25 each)

b. CCW
STAY-THE-SAME
2
4

(+0.25 each)

Reference(s) 6.12

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 1 of 2, Section 8, 1982, p. 3 of 5.

2. St. Lucie: Electrical Systems, Book 7, Training Department, Containment Ventilation System, pp. SD29-Rev.0-8 - 0.9.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.13

Below is a list of statements/facts referring to the HPSI Systems at St. Lucie 1 and 2. For each statement/fact, list UNIT 1, UNIT 2, UNIT 1 and 2, or NEITHER, thereby indicating the Unit(s) for which the statement/fact is correct. (2.5)

a. For normal system and power-source alignment, two (2) and only two (2) HPSI pumps START upon receipt of a SIAS.

b. The HPSI pumps are sized such that one (1) pump could deliver saturated water at a rate sufficient to maintain the core flooded and match decay heat boil-off at the time the ECCS switches to the recirculation mode, not less than 20 minutes after the LOCA.

c. The refueling water tank (RWT) is designed to provide a reservoir of borated water for the injection mode. The tank is maintained at 200 psig with a nitrogen cover gas.

d. For normal system and power-source alignment, with a SIAS and with a RCS pressure of 1000 psig, HPSI pumps A and B would be providing water to the RCS.

e. For normal system and power-source alignment, a SIAS would OPEN the four (4) header-isolation valves connecting pump A and the injection lines. Four (4) other valves would operate in a similar manner for pump B.

ANSWER 6.13

a. Units 1 and 2

b. Units 1 and 2

c. Neither

d. ~~Unit 2~~ UNITS 1 and 2 BOW

e. Units 1 and 2

(+0.5 each)

-Section 6.0 Continued on Next Page-

Points
Available

Reference(s) 6.13

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, pp. SD24-Rev.1-13 - 1-16.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.14

Below is a list of statements/facts referring to the LPSI Systems at St. Lucie 1 and 2. For each statement/fact, list UNIT 1, UNIT 2, UNIT 1 and 2, or NEITHER, thereby indicating the Unit(s) for which the statement/fact is correct. (2.5)

a. A portion of the LPSI-pump discharge flow is cooled by CCW and is recirculated to the pump-shaft seals to help extend seal life.

b. The discharge flow from the two (2) LPSI pumps combines and then flows through an air-operated flow-control valve into the LPSI low-pressure header.

c. The flowrate into each of the four (4) injection legs is individually measured by a flowrate sensor.

d. The LPSI discharge-headers connected to pump A and to pump B are protected against overpressurization by two (2) relief valves, one (1) for each pump header.

e. The LPSI System can be aligned to provide flow to the two (2) hot-leg injection lines.

ANSWER 6.14

a. Unit 1

b. Unit 1

c. ~~Unit 2~~ Units 1+2

d. Unit 2

e. Unit 1

(+0.5 each)

-Section 6.0 Continued on Next Page-

Points
Available

Reference(s) 6.14

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, pp. SD24-Rev.1-16 - 1-18.

-Section 6.0 Continued on Next Page-

Points
Available

QUESTION 6.15

Answer the following parts of this QUESTION, all of which pertain to the Containment Spray System, by "filling-in the blanks".

a. For the injection mode at Unit 2, each containment spray pump is designed for _____ (± 500) gpm with a discharge pressure of _____ (± 50) psig. (1.0)

b. At Unit 2, the hydrazine system is sized such that (without replenishment) the hydrazine solution could be injected into the containment for about one (1) ____ (hour, day, week). Flow of the hydrazine solution would be automatically stopped by a signal from _____ _____. (1.0)

ANSWER 6.15

a. 2700 ± 500 gpm (+0.5)
200 ± 50 ~~gpm~~ psig (+0.5)

b. hour (+0.5) or day Bake
a LO-level switch on the hydrazine storage tank (+0.5)

Reference(s) 6.15

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, pp. SD24-Rev.1-20 - 1-25.

-End of Section 6-

Points
Available

7.0 PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL (30.0)

QUESTIONS 7.01 through 7.06, are "multiple-choice" questions.

QUESTION 7.01

While operating at 100% of full power at Unit 1, all four (4) Reactor Coolant Pumps (RCPs) are tripped. Fifteen (15) minutes after tripping the RCPs, verification of natural-circulation flow cannot be verified if (1.0)

(a.) the loop ΔT is less than the full-power ΔT.

(b.) the cold-leg temperature, T_C, is constant or decreasing.

(c.) the hot-leg temperature, T_H, is steadily increasing.

(d.) no abnormal temperature difference exists between the T_H RTDs and the core-exit thermocouples (CETs).

ANSWER 7.01

(c.) **(+1.0)**

Reference(s) 7.01

1. St. Lucie: Off-Normal Operating Procedure, 1-0030140, Rev. 29, Blackout Operation, 5.10, p. 6.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.02

If an inadvertent SIAS at Unit 1 was received (1.0)

(a.) all four (4) RCPs would automatically trip.

(b.) the CCW to the RCPs would be isolated.

(c.) the HPSI pumps would inject water into the RCS.

(d.) a CSAS would be initiated.

ANSWER 7.02

(b.) **(+1.0)**

Reference(s) 7.02

1. St. Lucie: Emergency Operating Procedures, 1-EOP-03, Loss of Coolant Accident, p. 3.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.03

The Unit 1 hydrogen recombiner should always be placed in service when the hydrogen concentration in containment is between (1.0)

(a.) 0.5% and 3.5%

(b.) 1.5% and 3.5%

(c.) 3.5% and 4.0%

(d.) 3.5% and 10.0%

ANSWER 7.03

(a.) **(+1.0)**

Reference(s) 7.03

1. St. Lucie: Emergency Operating Procedure, 1-EOP-03, Loss of Coolant Accident, p. 21.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.04

After the receipt of a CIAS at Unit 1 there should be (1.0)

(a.) one (1) containment purge exhaust fan ON.

(b.) two (2) shield-building exhaust fans ON.

(c.) two (2) Diesel-Generators ON and LOADED.

(d.) four (4) control-room ventilation isolation valves OPEN.

ANSWER 7.04

(b.) **(+1.0)**

Reference(s) 7.04

1. St. Lucie: Emergency Operating Procedure, 1-EOP-03, Loss of Coolant Accident, pp. 37 - 38.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.05

If a Steam-Generator tube rupture occurs at Unit 1 and if all RCPs are stopped, RCP restart criteria cannot be met if (1.0)

(a.) the CCW has been lost for 4 minutes.

(b.) the RC is 30°F subcooled.

(c.) the Pressurizer level is 40%.

(d.) the unaffected Steam-Generator level is 30% wide range.

ANSWER 7.05

(d.) **(+1.0)**

Reference(s) 7.05

1. St. Lucie: Emergency Operating Procedure, 1-EOP-04, Steam Generator Tube Rupture, p. 6.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.06

If the HPSI pumps were running during an excess-steam demand event at Unit 1, the HPSI pumps should not be throttled or stopped if (1.0)

(a.) the RC is 40°F subcooled.

(b.) the Pressurizer level is 20%.

(c.) both Steam-Generator levels are 50%.

(d.) the reactor-vessel level is 60%.

ANSWER 7.06

(b.) **(+1.0)**

Reference(s) 7.06

1. St. Lucie: Emergency Operating Procedure, 1-EOP-05, Excess Steam Demand, p. 6.

QUESTION 7.07

Answer this QUESTION by "filling-in the blank". The Operating Procedure, OP-2-0030121, "Reactor Plant Heat-up - Cold to Hot Standby," states that, "hot-leg suction valves 3651, 3652, 3480, and 3481 must be OPEN when RC temperature is < 131°F to ensure _____ protection. (0.5)

ANSWER 7.07

LTOP **(+0.5)**

Reference(s) 7.07

1. St. Lucie: Operating Procedures, 2-0030121, Reactor Plant Heat-up - Cold to Hot Standby, p. 6.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.08

List the three (3) conditions that require emergency boration at Unit 1. (1.5)

ANSWER 7.08

1. Unanticipated or uncontrolled RCS cooldown following a reactor trip **(+0.5)**

2. Unexplained or uncontrolled reactivity increase **(+0.5)**

3. Loss of shutdown margin due to excessive CEA insertion **(+0.5)**

Reference(s) 7.08

1. St. Lucie: Off-Normal Operating Procedures, 1-0250030, Rev. 4, Emergency Boration, p. 2.

QUESTION 7.09

When the turbine is spinning at greater than 180 rpm at Unit 2, why must vacuum be maintained in the condenser? (1.0)

ANSWER 7.09

to prevent heating the rotor due to windage **(+1.0)**

Reference(s) 7.09

1. St. Lucie: Operating Procedures, 2-0030124, Rev. 12, Turbine Startup Zero to Full Load, p. 1.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.10

Answer TRUE or FALSE. Upon opening a shipping container to receive a new fuel element, it would be permissible if a few inches of water were found in the container. (0.5)

ANSWER 7.10

delete

TRUE (+0.5)

Reference(s) 7.10

1. St. Lucie: Operating Procedures, 2-1610020, Receipt and Handling of New Fuel, 8.4.2 Note, p. 7.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.11

Define the following radiological terms

a. Radiation Area (0.5)

b. Hot-Spot Area (0.5)

c. Locked High-Radiation Area (0.5)

d. Contaminated Area. (0.5)

ANSWER 7.11

a. > 5 mR/hr or > 100 mR in 5 days. **(+0.5)**

b. Hot Spot Areas are areas on pipes and/or equipment, located in accessible areas, where the average radiation level is less than that of a High Radiation Area, and where the reading is more than ten (10) times that of a Radiation Area, but not less than 100 mR/hr. **(+0.5)**

c. Locked High Radiation Area is any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any 1 hour a dose in excess of 1000 millirem. **(+0.5)**

d. Contaminated Area is any area which contains transferable surface radioactive contamination in excess of 1000 dpm/100 cm^2 averaged over a major portion of the area. **(+0.5)**

Reference(s) 7.11

1. St. Lucie: Health Physics Manual, HP-2, Sections 5.1.4, 5.1.5, 5.1.9, 5.1.10, p. 16.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.12

With a cold Turbine at Unit 2, turbine roll and startup should be performed in the " _____ _____ " mode of operation. A transfer to " _____ _____ " mode is performed when the unit is at some significant load. (1.0)

ANSWER 7.12

"single valve" **(+0.5)**
"sequential valve" **(+0.5)**

Reference(s) 7.12

1. St. Lucie: Operating Procedures, 2-0030124, Rev. 12, Turbine Startup Zero to Full Load, Section 4.14, p. 2.

QUESTION 7.13

Operation of the Unit 2 Turbine Generator at low frequency is to be avoided due to the probable occurrence of _____ _____. Fill in the blanks. (0.5)

ANSWER 7.13

blade resonance **(+0.5)**

Reference(s) 7.13

1. St. Lucie: Operating Procedures, 2-0030124, Rev. 12, Turbine Startup Zero to Full Load, Section 4.13, p. 2.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.14

Answer TRUE or FALSE. "New fuel-shipping containers should not be stacked more than five (5) high!" (0.5)

ANSWER 7.14

FALSE **(+0.5)**

Reference(s) 7.14

1. St. Lucie: Operating Procedures, 2-1610020, Receipt and Handling of New Fuel, Section 4.19, p. 2.

QUESTION 7.15

If emergency boration is required at Unit 1, what are the six (6) IMMEDIATE OPERATOR ACTIONS? (3.0)

ANSWER 7.15

1. Place the mode selector switch in the MANUAL or BORATE position. **(+0.5)**
2. Verify V-252 (boron load control valve) is closed. **(+0.5)**
3. Start either 1A or 1B boric acid pump. **(+0.5)**
4. Close V-2510A V-2511 (recirculation valves). **(+0.5)**
5. Open V-2514 (emergency borate valve). **(+0.5)**
6. If V-2514 fails to open, open either V-2508 or V-2509 (gravity free valves) and closed V-2501 (VCT outlet). **(+0.5)**

Reference(s) 7.15

1. St. Lucie: Off-Normal Operating Procedures, 1-0250030, Rev. 4, Emergency boration, p. 3.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.16

"Fill-in the blanks" for the following table according to the 10CFR20 Limits for external occupational exposure. (3.0)

1. _____/QTR whole body - without NRC Form 4
   _____/QTR whole body - with NRC Form 4
   provided the _____ accumulated occupational dose does not exceed _____.

2. _____/QTR - skin

3. _____/QTR - extremities

ANSWER 7.16

1. 1-1/4 rem (+0.5)
   3 rem (+0.5)
   lifetime (+0.5)
   5(N-18), N = age (+0.5)

2. 7.5 rem (+0.5)

3. 18.75 (+0.5)

Reference(s) 7.16

1. Generic: Code of Federal Regulations, Energy, 10, Revised January 1, 1981, Section 10CFR20.101, pp. 204-205.

2. St. Lucie: Health Physics Manual, HP-2, Section 6.1.1.1, p. 23.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.17

Answer this QUESTION by "filling-in the blanks". During Unit 2 reactor plant heatup - cold to hot standby, when RCS temperature reaches 406°F, the Operating Procedure directs you to adjust PIC-2201 to obtain approximately 100 gpm letdown flow. A caution statement states, "if no Pressurizer-level instruments indicate a change in level within 30 minutes, _____ _____ and investigate." (1.0)

ANSWER 7.17

balance charging and letdown (+1.0) OR terminate evolution.

Reference(s) 7.17

1. St. Lucie: Operating Procedures, 2-0030121, Reactor Plant Heat-up - Cold to Hot Standby, p. 6.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.18

What are the immediate operator actions on a complete loss of off-site electrical power? [Procedure 1-0030140 (Blackout Operation)] (5.0)

ANSWER 7.18

1. Trip Turbine and reactor manually. **(+0.5)**
2. Ensure all CEAs are fully inserted and reactor trip breakers are open. **(+0.5)**
3. Ensure turbine valves are closed. **(+0.5)**
4. Ensure Generator Exciter Supply breaker and Generator breakers are OPEN. **(+0.5)**
5. Place Reheater Control System in MANUAL, the CLOSE TCVs. **(+0.5)**
6. Ensure that Diesel Generators have started and are feeding only emergency buses. **(+0.5)**
7. Open Startup Transformer breakers. **(+0.5)**
8. Reduce Tavg to reference setpoint (Tref = 532^{o}F) by manual operation of the Atmospheric Steam Dump valves. **(+0.5)**
9. Isolate S/G blowdown. **(+0.5)**
10. Verify 1C steam-driven AFW Pump has started and has established flow to the S/Gs. If AFW Pumps have started due to the auto start feature, manual control can be taken after the auto actions are completed. **(+0.5)**

Reference(s) 7.18

1. St. Lucie: Off-Normal Operating Procedure, 1-0030140, Rev. 29, Blackout Operation, Section 4.0, p. 4.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.19

Answer TRUE or FALSE. A containment purge can be made at Unit 1 without a gaseous-release permit. (0.5)

ANSWER 7.19

FALSE **(+0.5)**

Reference(s) 7.19

1. St. Lucie: Operating Procedure, 1-0530021, "Controlled Gaseous Batch Release to Atmosphere", H.2, p. 1.

QUESTION 7.20

What four (4) conditions are checked according to 1-EOP-01 (Standard Post Trip Actions St. Lucie Unit 1) to verify plant electrical power requirements are satisfied? (2.0)

ANSWER 7.20

Verify plant electrical power requirements are satisfied by the following:

1. Turbine tripped (GVs and TVs closed). **(+0.5)**
2. Generator OCBs (8W26 and 8W30) and exciter breaker (CB FB 1) open. **(+0.5)**
3. Electrical auxiliaries transfer from Auxiliary to Start Up Transformers. **(+0.5)**
4. Verify at least one (1) DC bus is energized. **(+0.5)**

Reference(s) 7.20

1. St. Lucie: Emergency Operating Procedures, 1-EOP-01, Standard Post Trip Actions, p. 4.

-Section 7.0 Continued on Next Page-

Points
Available

QUESTION 7.21

What are the IMMEDIATE OPERATOR ACTIONS for Emergency Procedure 2-0030143 (Total Loss of AC Power)? (2.0)

ANSWER 7.21

IMMEDIATE OPERATOR ACTIONS:

1. Ensure all CEAs on bottom, and reactor trip breakers open. **(+0.5)**

2. Ensure 2C AFW Pump is restoring S/G level. **(+0.5)**

3. Close HCV-08-1A and HCV-08-1B (Main Steam Isolation Valves). **(+0.5)**

4. Isolate letdown flow by closing V-2515, V-2516, and V-2522 (Letdown isol.). **(+0.5)**

Reference(s) 7.21

1. St. Lucie: Emergency Procedure, 2-0030143, Rev. 8, Total Loss of AC Power, Section 4.0, p. 3.

-End of Section 7-

Points
Available

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS (30.0)

QUESTIONS 8.01 through 8.05 are "multiple-choice" questions.

QUESTION 8.01

The definition that states,

> "This classification is represented by events which involve an actual or potential substantial degradation of the level of safety of the plant combined with a potential for limited uncontrolled releases of radioactivity from the plant."

applies to (1.0)

(a.) an Unusual Event.

(b.) an Alert.

(c.) a Site-Area Emergency.

(d.) a General Emergency.

ANSWER 8.01

(b.) **(+1.0)**

Reference(s) 8.01

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Procedures, 3100022E, Revision 14, Classification of Emergencies, p. 2.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.02

During plant emergencies which enable the release of radioactive material to the environment the Emergency Coordinator, or his designee, is responsible for (1.0)

(a.) ensuring that off-site monitoring is performed.

(b.) informing the appropriate off-site agencies concerning off-site field monitoring data.

(c.) the direction of the off-site monitoring team to ensure that their exposures are within 10 CFR 20 limits.

(d.) comparing estimated dose projections obtained from field measurements to those based on plant-release conditions.

ANSWER 8.02

(a.) **(+1.0)**

Reference(s) 8.02

1. St. Lucie: St. Lucie Plant Administrative Procedures E-Plant Implementing Procedures, 3100035E, Revision 3, Off-site Radiological Monitoring, pp. 1-2.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.03

The person directly responsible for maintaining the Disconnected Lead and Temporary Jumper Log is the (1.0)

(a.) NPS

(b.) ANPS

(c.) STA

(d.) Reactor Control Operator

ANSWER 8.03

(d.) **(+1.0)**

Reference(s) 8.03

1. St. Lucie: St. Lucie Plant Administrative Procedures, 0010124, Revision 12, Control and Use of Jumpers and Disconnected Leads in Safety Related Systems, p. 4.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.04

Authorizing, placing and removal of all Caution Tags which identify Electrical Department grounds is the responsibility of the (1.0)

(a.) Operations Supervisor

(b.) Assistant Nuclear Plant Supervisor (ANPS)

(c.) Nuclear Plant Supervisor (NPS)

(d.) responsible Electrical Department Foreman or Supervisor

ANSWER 8.04

(d.) **(+1.0)**

Reference(s) 8.04

1. St. Lucie: St. Lucie Plant Administrative Procedures, 0010135, Revision 1, Caution Tag Clearance Procedure, p. 1.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.05

In event of a medical emergency at St. Lucie, the duties and responsibilities of the Emergency Coordinator include (1.0)

(a.) the notification during business hours of the Duty Call Supervisor who should notify Health Physics, the Operations Superintendent and the Emergency Control Officer.

(b.) the notification during business hours of the Plant Manager who should notify Health Physics the Operations Superintendent and the Emergency Control Officer.

(c.) ensuring that the victim's TLD f-reading dosimeter are transported with the victi LAWNWOOD MEDICAL CENTER.

(d.) ensuring that the victim is dec iated on-site and then transported to the LAWNWO AL CENTER.

ANSWER 8.05

(b.) **(+1.0)**

Reference(s) 8.05

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Proc ures, 3100021E, Revision 19, Duties and Responsibilities of the Emergency Coordinator, pp. 16-17.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.06

Prior to review by the FRG, jumpers/lifted leads may be installed in Safety Related Systems provided that three (3) criteria are met which are [select three (3)]: (1.5)

1. The calibration of the system would not be altered.

2. The intent of the system operation would not be altered.

3. The request has cleared the QC Department.

4. The request has been approved by two members of the plant staff at least one of whom holds an SRO license on the affected unit.

5. The request will be reviewed by the FRG and approved by the Plant Manager within 14 days of the installation.

ANSWER 8.06

2., 4., 5. (+.5 each)

Reference(s) 8.06

1. St. Lucie: St. Lucie Plant Administrative Procedures, 0010124, Revision 12, Control and Use of Jumpers and Disconnected Leads in Safety Related Systems, p. 5.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.07

Match one of the plant operating staff members given in Column A to one Emergency Function given in Column B. (2.5)

COLUMN A

1. Watch Engineer
2. Health Physics Supervisor
3. Nuclear Plant Supervisor
4. Shift Technical Advisor
5. Chemistry Supervisor

COLUMN B

a. Emergency Coordinator
b. Primary Radiation-Team Leader
c. Fire-Team Leader
d. Team Leader, First Aid/Decontamination
e. Accident assessment and initial technical support necessary for repair or corrective action

ANSWER 8.07

a. 3 (+0.5)

b 2 (+0.5)

c. 1 (+0.5)

d. 5 (+0.5)

e. 4 (+0.5)

Reference(s) 8.07

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Procedures, 3100023E, Revision 29, On-Site Emergency Organization and Roster, pp. 1-4.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.08

List four (4) emergencies generated by natural causes for which St. Lucie has developed Emergency Procedures. (1.0)

ANSWER 8.08

Tornadoes

Hurricanes

Abnormal Water Level

Earthquakes

(+0.25 each)

Reference(s) 8.08

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Procedures, 3100024E, Revision 12, Natural Emergencies, p. 1.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.09

Answer this question by "filling-in the blank".

If an individual became contaminated during the performance of his duties, and must be transported off-site to a hospital for treatment of injuries sustained in the incident, this event would be classified as an _____. (0.5)

ANSWER 8.09

Unusual Event **(+0.5)**

Reference(s) 8.09

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Procedures, 3100022E, Revision 14, Classification of Emergencies p. 11.

QUESTION 8.10

Answer this question by "filling-in the blank".

During an emergency in which a controlled release will be necessary, prior to making any recommendations for off-site protective action, the Emergency Coordinator shall _____. (0.5)

ANSWER 8.10

determine (estimate) projected off-site doses **(+0.5)**

Reference(s) 8.10

1. St. Lucie: Plant Administrative Procedures and E-Plan Implementing Procedures, 311021E, Rev. 19, p. 19.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.11

The duties and responsibilities of the Emergency Coordinator includes the notification of the State of Flordia authorities. The notification message requires that the State be provided with four (4) pieces of meteorological data. One (1) of these pieces of data is the "stability class". List two (2) other pieces of meteorological data to be transmitted to the State. (1.0)

ANSWER 8.11

wind direction

wind speed

sectors affected

(+0.5 each, +1.0 max)

Reference(s) 8.11

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Procedures, 3100021E, Revision 19, Duties and Responsibilities of the Emergency Coordinator, p. 8.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.12

Answer the parts of this QUESTION by supplying the answer and by "filling-in the blanks".

In Off-Normal Operating Procedure, 2-0120037, "Reactor Coolant Gas Vent System Off-Normal Operation," there is listed the following SYMPTOM,

> "Plant events have occurred [such as Safety Injection Tank (SIT) discharge, rapid RCS cooldown, or core-uncovery events] that may result in the presence of a gaseous void in the vessel head."

a. What is the primary source of gas for the void following SIT discharge? (0.5)

b. What is the primary source of gas for the void following rapid RCS cooldown? (0.5)

c. What is the primary source of gas for the void following core-uncovery event? (0.5)

d. The procedure contains steps to determine the "Venting Time Period" in order to limit the concentration of _____ within _____. (0.5)

ANSWER 8.12

a. the nitrogen cover gas **(+0.5)**

b. RCS coolant flashing to steam **(+0.5)**

c. hydrogen from oxidation of the cladding **(+0.5)**

d. hydrogen **(+0.25)**
containment **(+0.25)**

Reference(s) 8.12

1. St. Lucie: Off-Normal Operating Operating Procedure, 2-0120037, Rev. 4, Reactor Coolant Gas Vent System Off-Normal Operation, pp. 1, 2, 9.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.13

Answer TRUE or FALSE to each of the responses to the following statement.

All holders of SRO Licenses who are Reactor Control Operators at St. Lucie Unit 2 shall (according to the Emergency Plan Implementing Procedure No. 3100034E) be prepared to (2.5)

a. assume the role of Emergency Coordinator.

b. assume the role of Team Leader for Decontamination.

c. estimate off-site radiation doses.

d. assume the role of directing the TSC.

e. determine the recommended off-site protective actions.

ANSWER 8.13

a. TRUE

b. FALSE

c. TRUE

d. FALSE

e. TRUE

(+0.5 each)

Reference(s) 8.13

1. St. Lucie: St. Lucie Plant Administrative Procedures and E-Plan Implementing Procedures, 3100034E, Revision 5, Maintaining Emergency Preparedness - Radiological Emergency Plan Training, p. 4.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.14

Answer this QUESTION by choosing the correct words to "fill-in-the-blank."

During the absence of the Shift Supervisor from the Unit 2 Control Room while the Unit is in Mode 5 or 6 the Technical Specifications state that a licensed (as a RO or SRO) STA _____ (may-be or cannot-be) designated to assume the Control Room command function. (0.5)

delete

ANSWER 8.14

may-be (+0.5)

Reference(s) 8.14

1. St. Lucie: St. Lucie Unit 2 Safety Technical Specifications, Minimum Shift Crew Composition, Section 6.2, Table 6.2-1, p. 6-5.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.15

Answer this QUESTION by "filling-in-the-blanks".

At Unit 2, either a licensed RO or a SRO who is on shift ____ _____ (can or cannot) be a member of the Independent Safety Engineering Group (ISEG) because _____ _____. (1.0)

ANSWER 8.15

cannot

the person cannot be a member of ISEG and on shift at the same time.

(+0.5 each)

Reference(s) 8.15

1. St. Lucie: St. Lucie Unit 2 Safety Technical Specifications, Independent Safety Engineering Group, Administrative Controls, Section 6.2, p. 6-6.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.16

If there is an area within Unit 2 which is accessible to personnel, in which the radiation level is such that a person could receive to a major portion of the body in one hour a dose greater than 1000 mrem, and in which no enclosure exists (or could reasonably be constructed) to deny access by locks, then special provisions are required according to the Technical Specifications. List four (4) of these requirements. (1.0)

ANSWER 8.16

- rope-off or barricade the area
- post the area in a conspicuous manner
- provide a flashing light
- entrance shall be controlled by a RWP
- any individual entering the area shall be provided with
  - a radiation monitoring device that continuously indicates the radiation dose rate
  - a radiation monitoring device that continuously integrates the radiation dose rate and alarms when a preset integrated dose is received
  - an accompanying HP-qualified individual with a radiation dose rate monitoring device who is responsible for the HP functions

(+0.25 each, +1.0 max)

Reference(s) 8.16

1. St. Lucie: St. Lucie Unit 2 Safety Technical Specifications, Section 6.12.2, p. 6-24.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.17

Answer this QUESTION by "filling-in-the-blanks".

In Mode 1 at Unit 2, the LCO for the Auxiliary Feedwater System requires that at least _____ independent Steam-Generator Auxiliary Feedwater Pumps and associated flow paths shall be operable. The bases for this LCO is that the Auxiliary Feedwater System ensures that _____
_____
_____
_____. (1.5)

ANSWER 8.17

3 **(+0.5)**

the RCS can be cooled-down to less than 350°F from normal operating conditions in the event of a total loss of off-site power. **(+1.0)** (325°F is the temperature value in the bases for the Unit 1 Tech. Specs; 325°F is acceptable in the ANSWER.)

Reference(s) 8.17

1. St. Lucie: St. Lucie Unit 2 Safety Technical Specification, Bases, Auxiliary Feedwater System, Section 3/4.7.1.2, p. B 3/4 7-2.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.18

Answer the parts of this QUESTION by "filling-in the blanks".

a. At St. Lucie Unit 2, the Technical Specifications specify an allowable peak linear heat rate for operation in Mode 1. At BOL, this limit is _____ (11, 13, or 15) kW/ft, while at EOL it is _____ (11, 13, or 15) kW/ft. (1.0)

b. One method of determining that this limit is being met requires verification that the ASI is without its limits. If ASI was 0.0, then operation at _____ % of rated thermal would be allowed. (0.5)

ANSWER 8.18

a. 13 (+0.5)
13 (+0.5)

b. 100% (+0.5) or 88%

Reference(s) 8.18

1. St. Lucie: St. Lucie Unit 2 Safety Technical Specifications, Power Distribution Limits, Section 4.2.1.4.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.19

The Technical Specifications for Unit 1 place a lower limit on T_{avg}. What is the basis for this LCO? (1.0)

ANSWER 8.19

The MTC would become less negative (more positive) with decreasing T_{avg}. Hence limiting T_{avg} to being above a lower limit ensures that the maximum positive and/or negative values of the MTC will not be exceeded. **(+1.0)**

Reference(s) 8.19

1. St. Lucie: St. Lucie Unit 1 Safety Technical Specifications, Bases Section 3/4.1.1.5.

Points
Available

QUESTION 8.20

Assume a Safety Limit Violation has occurred at Unit 1. According to the Unit 1 Technical Specifications four (4) actions must be taken. List two (2). (2.0)

ANSWER 8.20

- The facility shall be placed in at least HOT STANDBY **(+0.8)** within 1 hour **(+0.2)**.
- The Safety Limit violation shall be reported to proper authorities (NRC, the President of Power, and to the CNRB) **(+0.8)** within 24 hours **(+0.2)**.
- A Safety Limit Violation Report shall be prepared. **(+1.0)**
- The Safety Limit Violation Report shall be submitted to proper authorities (NRC, etc.) **(+0.8)** within 10 days of the violation **(+0.2)**.

(+1.0 each, +2.0 maximum)

Reference(s) 8.20

1. St. Lucie: Unit 1 Technical Specifications, Section 6.7, p. 6-13.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.21

Define IDENTIFIED LEAKAGE by listing the three (3) types. (3.0)

ANSWER 8.21

1. Leakage (except CONTROLLED LEAKAGE) into closed systems from pump seals or valve packing that are captured and conducted to a sump or collecting tank. **(+1.0)**

2. Leakage into containment atmosphere from specifically known sources but that is not PRESSURE BOUNDARY LEAKAGE. **(+1.0)**

3. RCS leakage through a steam generator to the secondary system. **(+1.0)**

Reference(s) 8.21

1. St. Lucie: Unit 1 Technical Specifications, Definitions, p. 1-3.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.22

Unit 1 Technical Specification 3.7.2.1 requires that the temperature of both the primary and secondary coolants be greater than 70°F when the pressure of either coolant in the Steam Generator is greater than 200 psig. What is the basis for this specification? (1.0)

ANSWER 8.22

Conditions that could produce brittle fracture must be prevented. **(+1.0)**

Reference(s) 8.22

1. St. Lucie: Unit 1 Technical Specification 3/4.7.2, p. 3/4 7-13.

2. St. Lucie: Unit 1 Technical Specification Bases, p. 3/4 7-3.

-Section 8.0 Continued on Next Page-

Points
Available

QUESTION 8.23

According to Unit 1 Technical Specifications, two (2) separate and independent D/G sets are required. Each D/G system must meet three (3) requirements relating to the availability of fuel. List two (2). (If a requirement includes an amount of fuel in gallons, the amount need only be specified within a factor of 2.) (1.0)

ANSWER 8.23

- engine-mounted fuel tanks **(+0.3)** containing ≥ 152 (76 to 304) gallons of fuel **(+0.2)**
- fuel-storage system **(+0.3)** containing ≥ 16,450 (8225 to 32,900) gallons of fuel **(+0.2)**
- fuel-transfer pump **(+0.5)**

(+1.0 maximum)

Reference(s) 8.23

1. St. Lucie: Unit 1 Technical Specifications, Section 3/4 8.1, p. 3/4 8-1.

-End of Section 8.0-

ST. LUCIE PLANT
ADMINISTRATIVE PROCEDURE 0010140, REVISION 1
CONTROL OF OPERATOR AIDS

ATTACHMENT (3)

PLANT PHYSICS CURVE BOOK — UNIT 1
TABLE OF CONTENTS — CYCLE 6

		DATE
A.	ECC Curves, OP 0030126	
A.1	Power Defect Reactivity	3/12/84
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A.3	Xenon Reactivity - Xenon Worth vs Power	6/5/85
A.4	Xenon Reactivity - Xenon Worth vs Time after Shutdown	6/5/85
A.5	Samarium/Neptunium Reactivity	6/5/85
A.6	CEA Withdrawal Reactivity - Integral Overlap Worth	3/12/84
A.7	CEA Withdrawal Reactivity - Lead Bank Worth	3/12/84
A.8	Boron Worth vs Burnup Curve (HZP)	3/12/84
B.	Shutdown Margin Modes 2, 3, 4, 5 (Subcritical) Curves, OP 0110056	
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B.3	Reactivity Deviation Log	8/23/83
B.4	Stuck CEA - CEA Worth	3/12/84
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C.	Other Cycle Dependent Physics Information	
C.1	Boron Worth vs Burnup Curve (EFP)	3/12/84
C.2	Critical Boron Concentration vs Burnup Curve (EFP)	4/3/85
C.3	Operator Information (ZSI, T_c^T, etc.)	8/23/83
C.4	MTC vs Burnup (EFP)	3/12/84

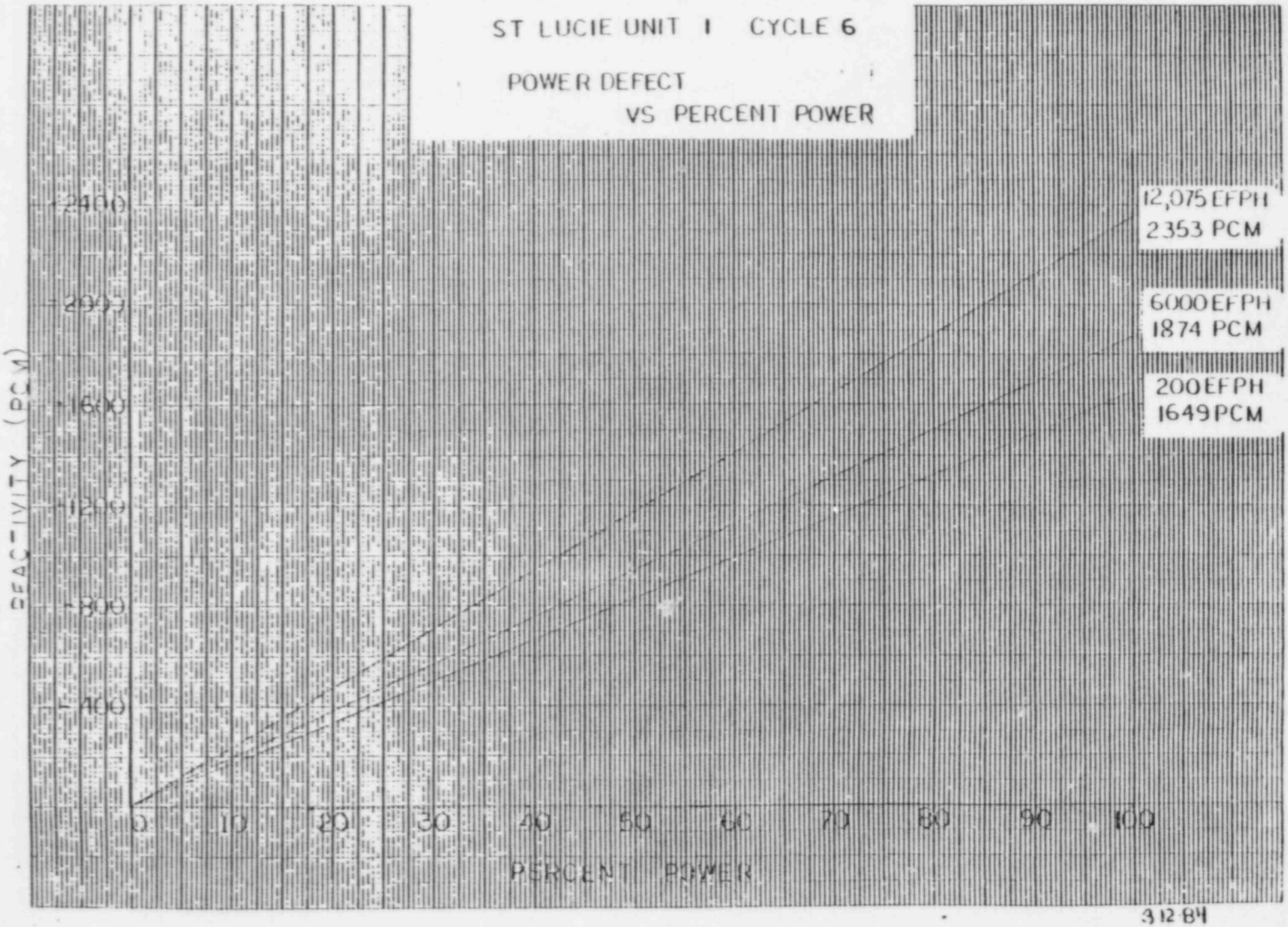
Approved by _____ Date 6/6/85
Reactor Engineering Supervisor

Approved by _____ Date 6/6/85
Operations Supervisor

Approved by _____ Date 6/6/85
for Plant Manager, FRG

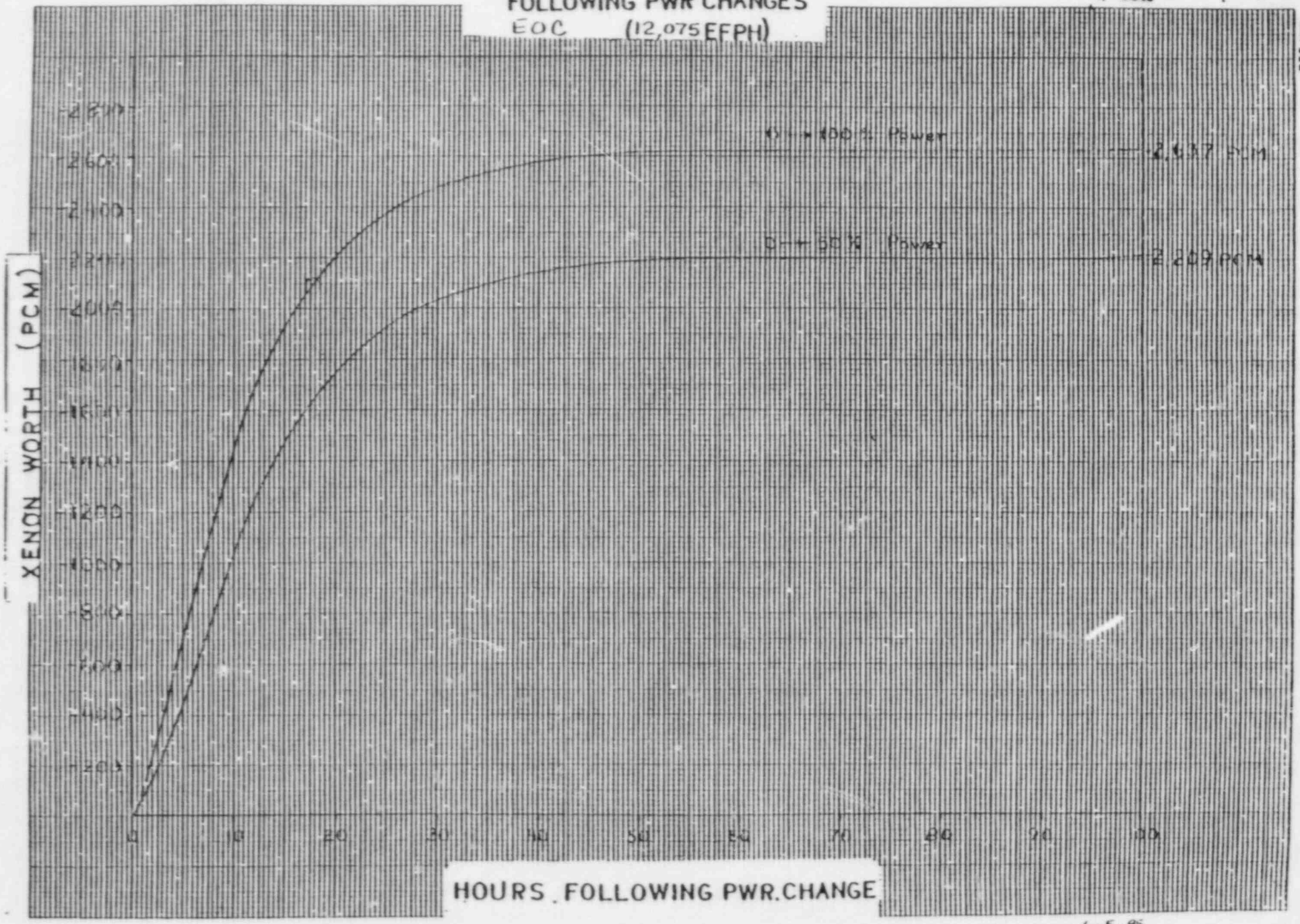
/R1

FIG. A.1


ST LUCIE UNIT 1 CYCLE 6
POWER DEFECT
VS PERCENT POWER
12,075 EFPH
2353 PCM
6000 EFPH
1874 PCM
200 EFPH
1649 PCM
REACTIVITY (PCM)
-2400
-2000
-1600
-1200
-800
-400
0
10
20
30
40
50
60
70
80
90
100
PERCENT POWER
3 12 84

STLU 1 FIG A.2 CYCLE 6

XENON BUILD UP TO EQUIL.
FOLLOWING PWR CHANGES
EOC (12,075 EFPH)



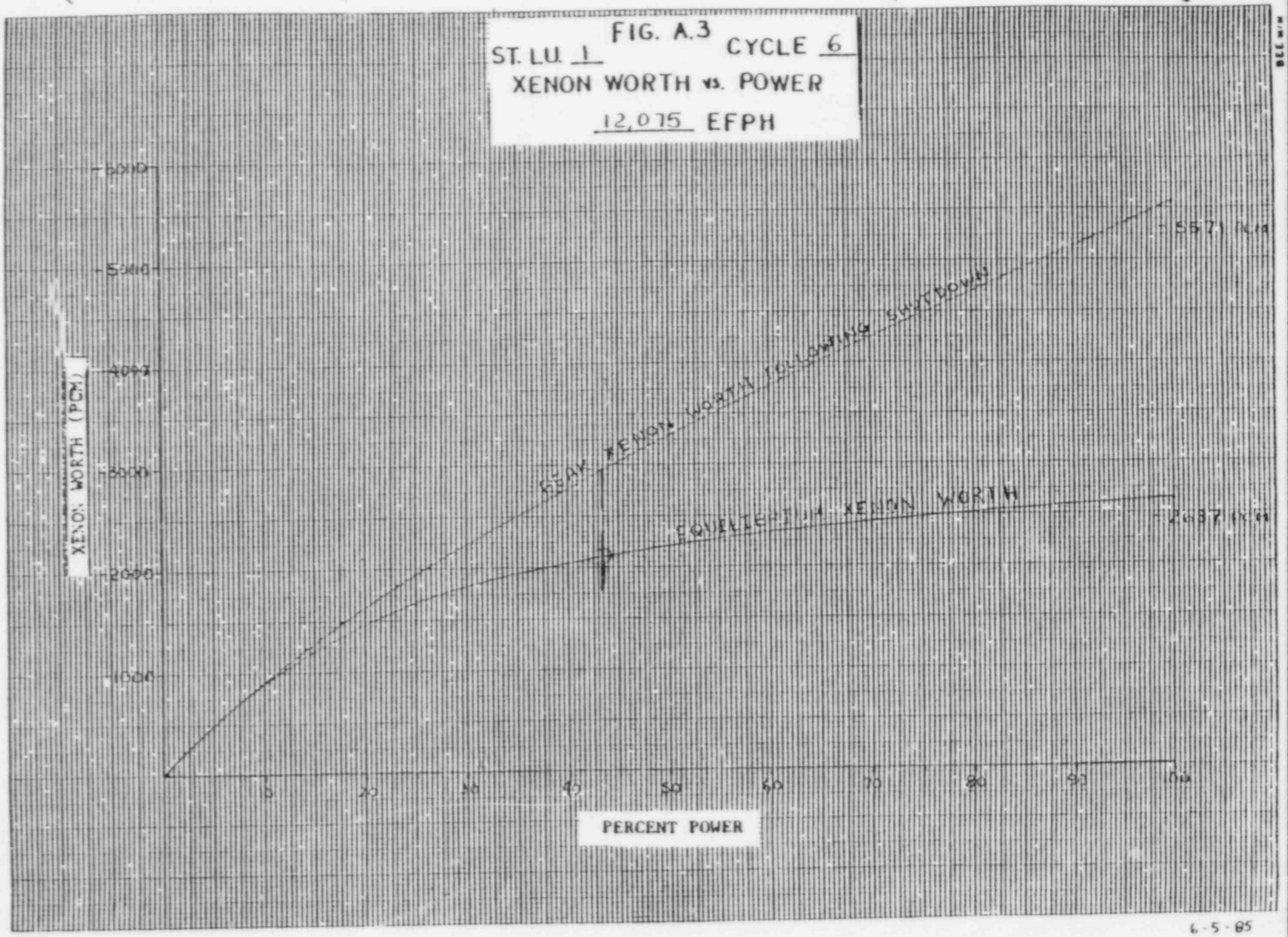
6-5-85

FIG. A.3

ST. LU. 1 CYCLE 6

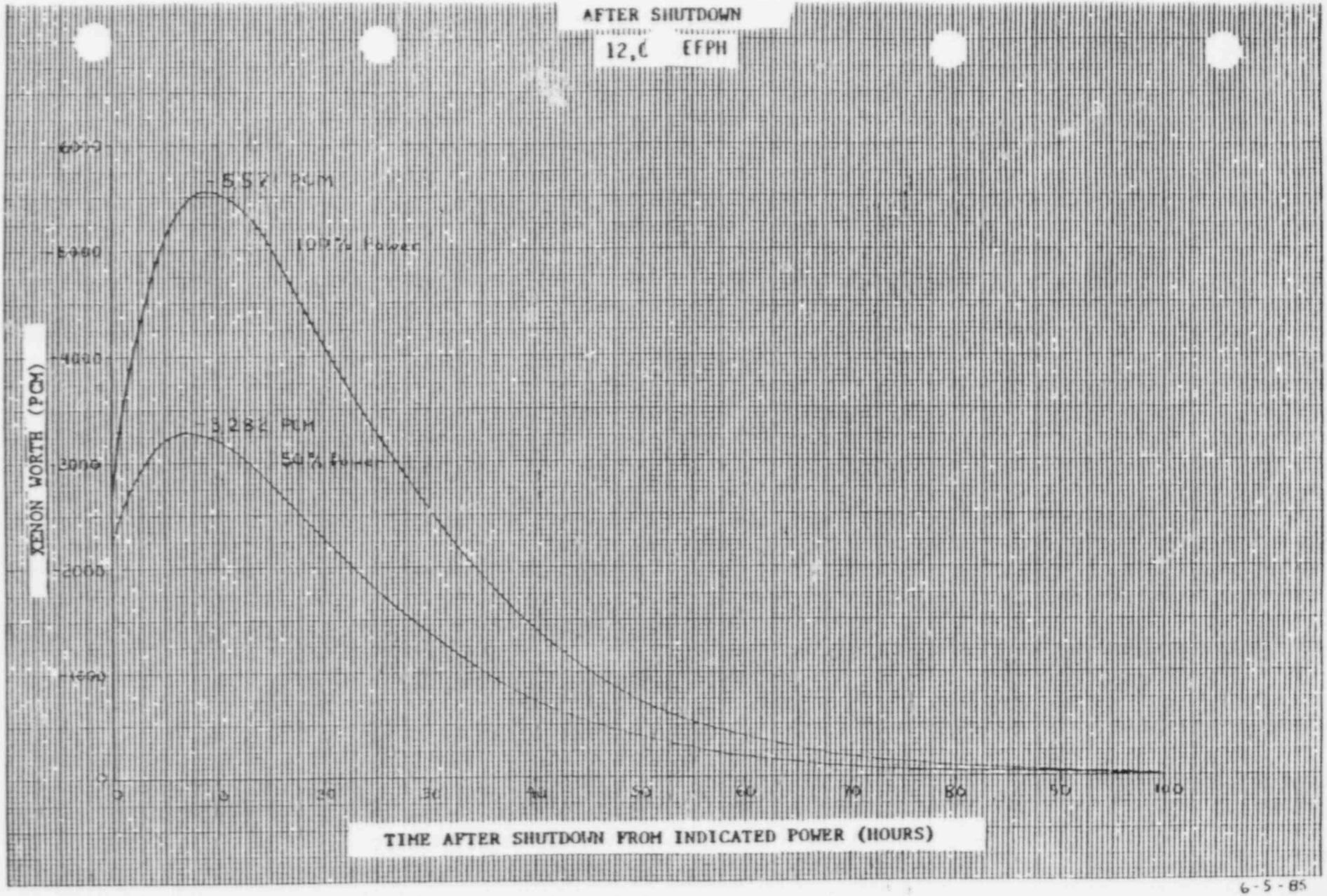
XENON WORTH vs. POWER

12,075 EFPH



6-5-85

1


AFTER SHUTDOWN
12,C EFPH
-5521 PCM
100% Power
-3284 PCM
50% Power
XENON WORTH (PCM)
TIME AFTER SHUTDOWN FROM INDICATED POWER (HOURS)

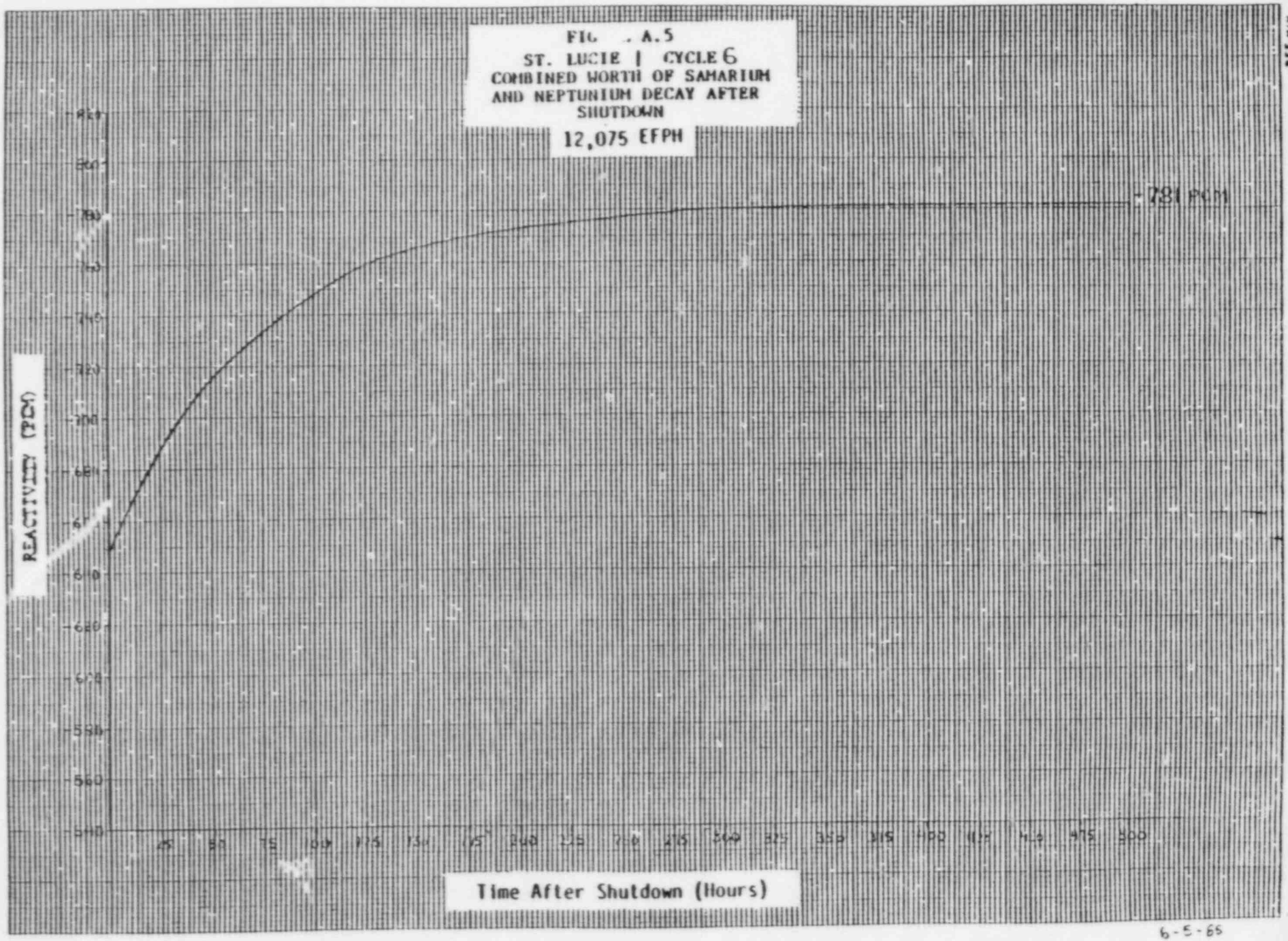
6-5-85

FIG . A.5

ST. LUCIE I CYCLE 6

COMBINED WORTH OF SAMARIUM AND NEPTUNIUM DECAY AFTER SHUTDOWN

12,075 EFPH



6-5-65

461510

FIG. A

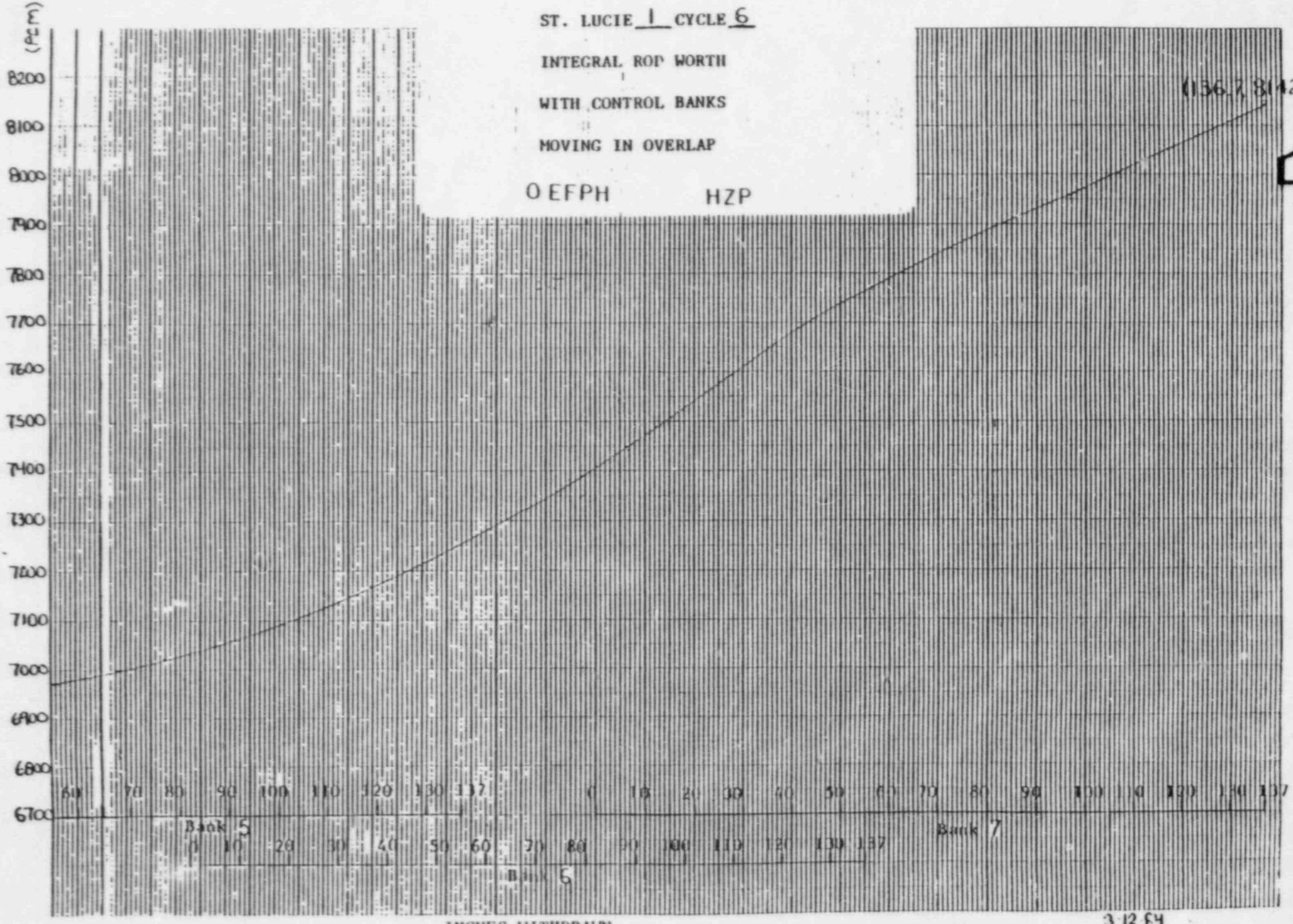
ST. LUCIE 1 CYCLE 6

INTEGRAL ROD WORTH

WITH CONTROL BANKS

MOVING IN OVERLAP

0 EFPH HZP



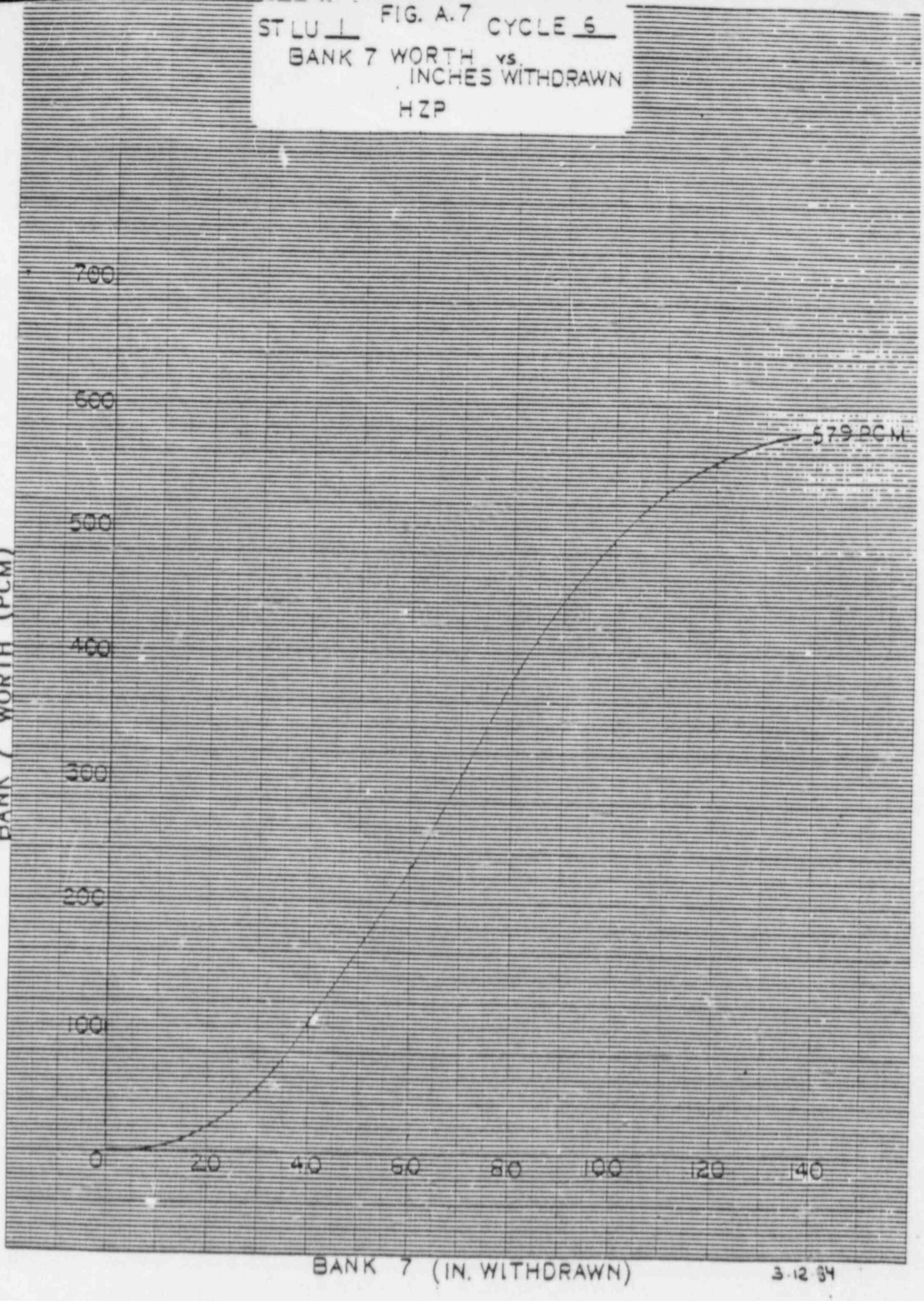
3-12-84

FIG. A.7 CYCLE 6

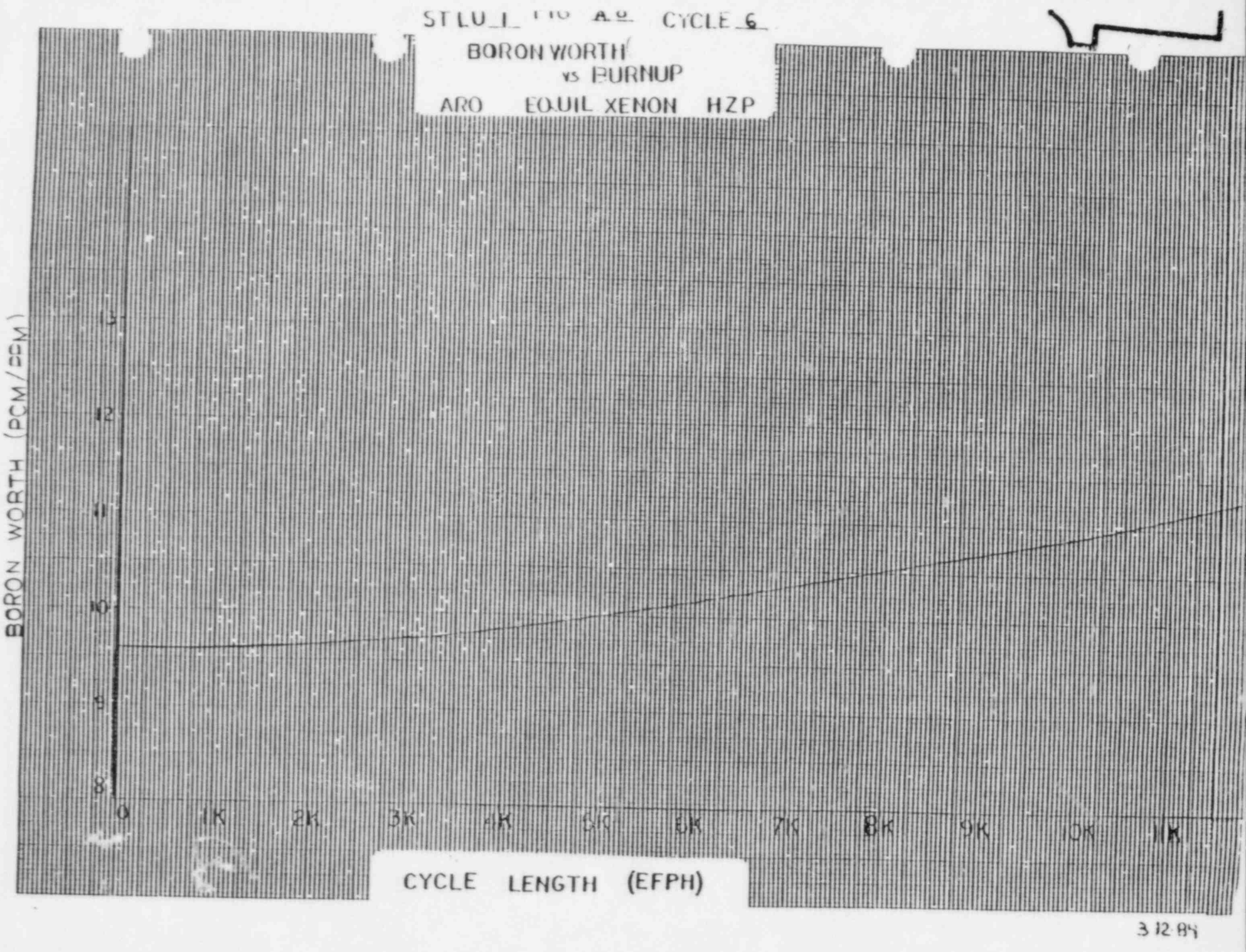
ST LU 1

BANK 7 WORTH vs. INCHES WITHDRAWN

HZP



3-12-84


CYCLE 6
BORON WORTH
vs BURNUP
ARO EQUIL XENON HZP
BORON WORTH (PCM/PPM)
13
12
11
10
9
8
0
1K
2K
3K
4K
5K
6K
7K
8K
9K
10K
11K
CYCLE LENGTH (EFPH)
3.12.84

EQUATION FORMULA AND PARAMETER SHEET

Where $\dot{m}_1 = \dot{m}_2$

$(\text{density})_1(\text{velocity})_1(\text{area})_1 = (\text{density})_2(\text{velocity})_2(\text{area})_2$

$KE = \frac{mv^2}{2}$ $\quad PE = mgh$ $\quad PE_1+KE_1+P_1V_1 = PE_2+KE_2+P_2V_2$ $\quad$ where V = specific volume, P = Pressure

$Q = \dot{m}c_p(T_{out}-T_{in})$ $\quad Q = UA\,(T_{ave}-T_{stm})$ $\quad Q = \dot{m}(h_1-h_2)$

$P = P_0 10^{(SUR)(t)}$ $\quad P = P_0 e^{t/T}$ $\quad SUR = \frac{26.06}{T}$ $\quad T = \frac{(\beta - \rho)}{\rho}\,\ell_m = \frac{(\beta - \rho)}{\rho\,\lambda_{eff}}$

delta $K = (K_{eff}-1)$ $\quad CR_1(1-K_{eff1}) = CR_2(1-K_{eff2})$ $\quad CR = S/(1-K_{eff})$

$M = \frac{(1-K_{eff1})}{(1-K_{eff2})}$ $\quad SDM = \frac{(1-K_{eff}) \times 100\%}{K_{eff}}$

decay constant $= \frac{\ln(2)}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ $\quad A_1 = A_0 e^{-(\text{decay constant})x(t)}$

Water Parameters

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3

Heat of Vaporization = 970 Btu/lbm
Heat of Fusion = 144 Btu/lbm
1 Atm = 14.7 psia = 29.9 in Hg

Miscellaneous Conversions

1 Curie = 3.7×10^{10} dps
1 kg = 2.21 lbs

1 hp = 2.54×10^3 Btu/hr

1 MW = 3.41×10^6 Btu/hr
1 Btu = 778 ft-lbf

Degrees F = (1.8 x Degrees C) + 32
1 inch = 2.54 centimeters
g = 32.174 $ft\text{-}lbm/lbf\text{-}sec^2$

1 ft H_2O = 0.4335 $lbf/in.^2$ $\quad \lambda_{eff} = 0.08\ sec^{-1}$

Joe Upton

U.S. NUCLEAR REGULATORY COMMISSION

REACTOR OPERATOR LICENSE EXAMINATION

Facility: St. Lucie 1 & 2 (50-335 & 389)

Reactor Type: PWR-CE

Date Administered: December 16, 1985

Examiner: Joe Upton

Candidate: Answer Key

master

INSTRUCTIONS TO CANDIDATE:

Print your name on the line above marked "Candidate." The grade points available for each question are indicated within parentheses after each question. The passing grade is 70% in each of the four (4) categories and is 80% for the total grade. Use separate paper for your answers and write on only one (1) side of the paper, unless a specific question instructs you otherwise. Staple this question package to your answer sheets. 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. When you have finished this examination, affirm the statement by signing your name.

Category Value	% of Total	Candidate's Score	% of Cat. Value	Category
30	25			1. Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow
~~30~~ 27.8	25			2. Plant Design Including Safety and Emergency Systems
30	25			3. Instruments and Controls
30	25			4. Procedures - Normal, Abnormal, Emergency and Radiological Control
~~120~~ 119.8				TOTALS

Final Grade _____ %

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

_____

Candidate's Signature

1/1

IE 42

FURTHER INSTRUCTIONS TO CANDIDATE

1. At the end of the written examination package is a copy of Figures A.1 through A.8 taken from the Unit 1 Plant Physics Curve Book. Use them as appropriate.

2. At the end of the written examination package is a reference page containing equations, formulas, and constants. Use them as necessary.

3. Use the "Steam Tables" as necessary.

St. Lucie 1 & 2
December 16, 1985

Points
Available

1.0 PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW (30.0)

QUESTIONS 1.01 through 1.05 are "multiple-choice" questions.

QUESTION 1.01

A tank contains water to a level of 40 ft above the bottom of the tank. A nitrogen cover gas is at 100 psia. The tank and its contents are at 70°F and the density of the water is 62.4 lbm/ft^3. The pressure at the bottom of the tank is (1.0)

(a.) 117 psig

(b.) 117 psia

(c.) 83 psig

(d.) 83 psia

ANSWER 1.01

(b.) **(+1.0)**

Reference(s) 1.01

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 3-11.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.02

If the temperature of the tank in QUESTION 1.01 (container, water and cover gas) were raised and if no water or cover gas was allowed to enter or leave the tank, the pressure at the bottom of the tank would (1.0)

(a.) increase because the water level would rise and the temperature of the gas has increased.

(b.) increase because the pressure due to the water would rise and the temperature of the gas has increased.

(c.) decrease because the water density has decreased.

(d.) decrease because the cover-gas density has decreased.

ANSWER 1.02

(a.) **(+1.0)**

Reference(s) 1.02

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 3-11, 38-40.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.03

The reactor at St. Lucie Unit 1 is called a "thermal reactor" because (1.0)

(a.) the reactor provides the thermal-energy input for the plant.

(b.) the thermal power produced by the reactor equals the power removed by the secondary-side of the plant (when in normal full-power operation).

(c.) on the average, the neutrons produced by the fissioning process are at an energy level that corresponds to the temperature of the surrounding material.

(d.) on the average, the neutrons causing fission are at an energy level that corresponds to the temperature of the surrounding materials.

ANSWER 1.03

(d.) **(+1.0)**

Reference(s) 1.03

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, p. 7.1-2.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.04

The isotope of plutonium, Pu^{239}, is found in the nuclear reactor core of St. Lucie Unit 1 because (1.0)

(a.) Pu^{239} is found in significant quantities (percentage wise) in pitchblend (the uranium material that is mined).

(b.) of the non-fission absorption of a thermal or epithermal neutron by U^{238} nuclei.

(c.) of the fissioning of U^{238} nuclei by fast neutrons.

(d.) of the non-fission absorption of a thermal neutron by U^{235} nuclei.

ANSWER 1.04

(b.) **(+1.0)**

Reference(s) 1.04

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, pp. 7.3-10 - 7.3.11.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.05

As the RCS temperature increases, the moderator temperature coefficient causes the reactivity of the core at the Unit 1 to decrease because (1.0)

(a.) the water density decreases, the neutrons (on the average) travel further distances and more of them would "leak" from the core.

(b.) the water density decreases, the neutrons (on the average) travel shorter distances and more of them would be absorbed in the core.

(c.) the water density increases, neutrons (on the average) travel further distances and more of them would "leak" from the core.

(d.) the water density increases, neutrons (on the average) travel shorter distances and more of them would be absorbed in the core.

ANSWER 1.05

(a.) **(+1.0)**

Reference(s) 1.05

1. Duke Power Company: FNRE, p. 150.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.06

Referring to Figure 1.06 (QUESTION), answer the following parts to the QUESTION by choosing the correct response or by "filling-in the blanks". The pump has been operating at 1/2 of its rated capacity.

a. Specify the direction of flow of the water through the filter by stating TO-THE-RIGHT or TO-THE-LEFT. (0.5)

b. Assume the filter's characteristics have not changed, but that the throttling valve has been changed to reduce the flowrate by a factor of 2. The difference in the water heights in the manometer would _____ (INCREASE or DECREASE) by a factor of _____. (1.0)

ANSWER 1.06

a. TO-THE-RIGHT (+0.5)

b. DECREASE (+0.5)
4 (+0.5)

Reference(s) 1.06

1. Generic: Academic Program for Nuclear Power Plant Personnel, Volume III, Nuclear Power Plant Technology, 1973, General Physics Corporation, pp. 2-127 - 2-132.

-Section 1.0 Continued on Next Page-

Points
Available

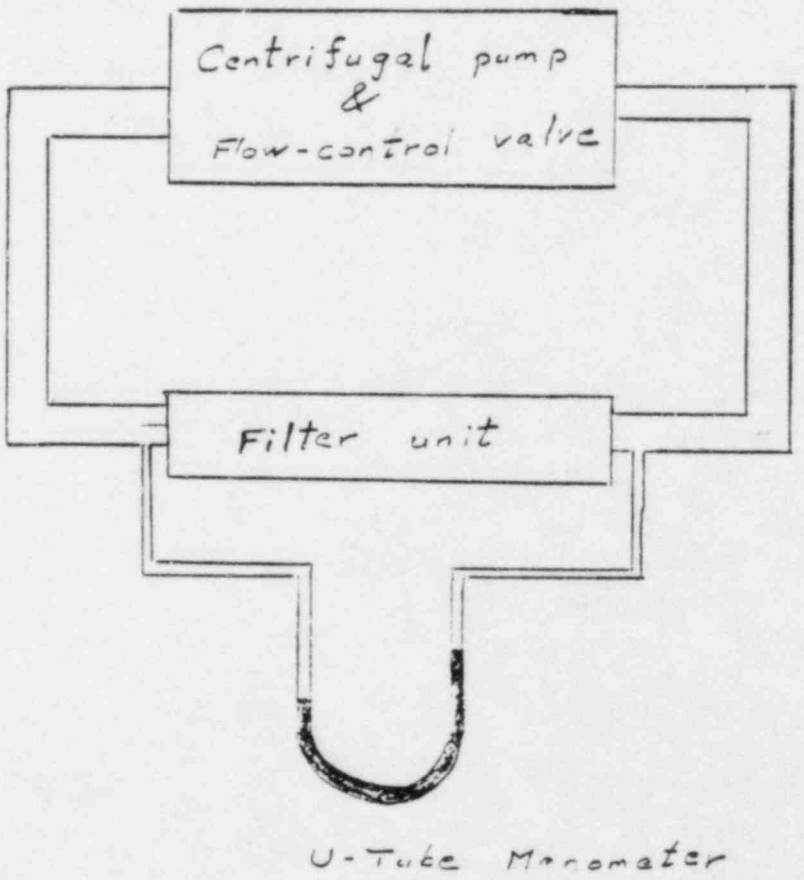


Figure 1.06 (QUESTION)

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.07

Answer the following parts of this QUESTION concerning the operation of the St. Lucie Unit 1 power plant in Cycle 6 with 12,075 EFPH.

a. If the plant had been operating at 100% of full power for 5 days, the magnitude of the xenon worth would be _____ pcm (±100 pcm). (0.5)

b. If the plant had been operating at 100% of full power for 17-1/2 hours (the plant had been in HOT STANDBY for 15 days before FULL-POWER operation) the magnitude of the xenon worth would be _____ pcm (±100 pcm). (0.5)

c. If the plant tripped while in the conditon of part "a.", the magnitude of the peak xenon worth would be _____ pcm (±100 pcm). (0.5)

d. If the plant tripped while in the condition of part "b.", the magnitude of the peak xenon worth would be _____ pcm (±300 pcm). (0.5)

e. When, in part "a.", the power level was dropped; the initial change in the "burnup" of Xe^{135} _____ (INCREASED, STAYED-THE-SAME or DECREASED) while the production of the Te^{135} and I^{135} _____ (INCREASED, STAYED-THE-SAME or DECREASED) and while rate-of-decay of I^{135} _____ (INCREASED, STAYED-THE-SAME or DECREASED). (1.5)

ANSWER 1.07

a. 2637 ± 100 pcm (+0.5)

b. 2100 ± 100 pcm (+0.5)

c. 5571 ± 100 pcm (+0.5)

d. ~~3200 ± 300 pcm~~ 2800 to 4300 pcm (+0.5)

e. DECREASED
DECREASED
STAYED-THE-SAME (+0.5 each)

-Section 1.0 Continued on Next Page-

Points
Available

Reference(s) 1.07

1. St. Lucie: Reactor Physics Training Document, Reactor Physics, pp. 7.5-6 - 7.5-15.

2. St. Lucie: Administrative Procedures, 0010140, Revision 1, Control of Operator Aids, Attachment (3), Plant Physics Curve Book, Figure A.2, A.3 and A.4.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.08

Answer the following parts of this QUESTION using Figure A.5 of the Plant Physics Curve Book for St. Lucie Unit 1 on Cycle 6, as appropriate.

a. If the Unit 1 power plant had been operating continuously at 50% of full power for 400 hours, what is the magnitude of the reactivity worth for samarium and neptunium? (0.5)

b. If the Unit 1 power plant had been operating continuously at 100% of full power for 400 hours, what is the magnitude of the reactivity worth for samarium and neptunium? (0.5)

c. If, after this 400 hours run at 100% of full power, the Unit 1 power plant tripped, the magnitued of the reactivity worth for samarium and neptunium would approach _____ pcm. (0.5)

ANSWER 1.08

a. 650 pcm ± 5 pcm **(+0.5)**

b. 650 pcm ± 5 pcm **(+0.5)**

c. 781 pcm ± 5 pcm **(+0.5)**

Reference(s) 1.08

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, pp. 7.5-16 - 7.5-19.

2. St. Lucie: Administrative Procedures, 0010140, Revision 1, Control of Operator Aids, Attachment (3), Plant Physics Curve Book, Figure A.5.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.09

Answer with TRUE or FALSE to each statement given below concerning subcritical operation of Unit 2 in Cycle 2.

a. If the reactor had been shutdown for 3 months, the source-range instruments would loose their ability to determine the level of the neutron flux because the flux level would be too low. (0.5)

b. The neutron flux level is determined primarily by the neutrons produced by the intrinsic sources, the largest of which is due to α-particle absorption in O^{18}. (0.5)

c. If the indicated count-rate by the source-range instruments doubled, the reactivity margin (to criticality) has been reduced by one-half. (0.5)

d. For each equal insertion (addition) of reactivity, it takes a longer amount of time for an equilibrium neutron-flux level to be reached as k_{eff} approaches unity. (0.5)

e. If 10 inches of CEA withdrawal increased the count-rate by a source range instrument by 10 cps, then 20 inches of CEA withdrawal would have increased the count-rate by 20 cps. (0.5)

ANSWER 1.09

a. FALSE (+0.5)

b. FALSE (+0.5)

c. TRUE (+0.5)

d. TRUE (+0.5)

e. FALSE (+0.5)

-Section 1.0 Continued on Next Page-

Points
Available

Reference(s) 1.09

1. St. Lucie: Reactor Physics Training Manual, Reactor Physics, Section 7.7.2.

2. Generic: Nuclear Energy Training, Volume 3, Reactor Operations, Unit 12, pp. 12.1-1 ff.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.10

Answer the following parts of this QUESTION by listing the answer or by "filling-in the blanks."

The heat transfer in the Steam Generators at St. Lucie involves a combination of both conduction and convection. The following equation for the combined (overall) heat transfer coefficient in (Btu/hr-ft^2-^{o}F) is typically used to describe this heat transfer.

$$U_o = \frac{1}{1 \quad + \Delta r/k + 1/h_2}$$

a. If U_o is known for a Steam Generator, what other data besides U_o must be known to calculate the rate of heat transfer (in Btu/hr) from primary coolant to the secondary water/steam? (1.0)

b. Consider two (2) Steam Generators; one is clean and new and one has heavy mineral deposits on the outer surfaces of the tubes. If the temperatures of the RC and the feedwater/steam are the same for both Steam Generators, then the rate of heat transfer (in Btu/hr) in the fouled-tube Steam Generator is _____ because the overall heat-transfer coefficient is _____ which could be represented by a ____ _____ k. Answer SMALLER or LARGER for each blank. (1.5)

ANSWER 1.10

a. overall ~~cross-sectional~~ surface area for heat transfer
overall temperature difference **(+0.5 each)**

b. SMALLER
SMALLER
SMALLER

(+0.5 each)

Reference(s) 1.10

1. St. Lucie: Reactor Physics Training Manual, Heat Transfer, pp. 2-151 - 2-155.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.11

The neutron multiplication factor, k_{eff}, has just changed from 0.920 to 1.004. Answer the following parts of this QUESTION by "filling-in the blanks".

a. The reactor is now _____. (SUBCRITICAL, EXACTLY CRITICAL, SUPER-CRITICAL or PROMPT CRITICAL) (0.5)

b. The reactivity of the core is now _____ pcm. (0.75)

c. The change in reactivity required in going from 0.920 1.004 was _____ pcm. (0.75)

ANSWER 1.11

a. SUPER-CRITICAL (+0.5)

b. ~~39.8 ± 0.2~~ 398 ± 2 pcm (+0.75)

c. ~~39.8 + 869.6 = 909.4~~ 398 + 8696 = 1094
~~909.4 ± 100pcm (+0.75)~~ 1094 ± 100 (+0.75)

Reference(s) 1.11

1. St. Lucie: Reactor Physics Training Document, Reactor Physics, pp. 7.5-1 - 7.5-2.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.12

An estimated critical position (ECP) has been calculated for a reactor startup that is to be performed 15 hours after a trip which was preceded by a 60-day run at 100% of full-power. For each of the parts to this QUESTION, specify whether the indicated actions would result in an actual critical rod position that is LOWER-THAN, HIGHER-THAN, or THE-SAME-AS the ECP.

a. feeding the Steam Generators to increase their level by 15% assume just accomplished (0.5)

b. delaying the startup by 6 hours longer than the planned 15 hours (0.5)

c. increasing the steam-dump pressure setpoint by 100 psig (0.5)

d. increasing the Pressurizer level by using the dilute mode of boron-concentration control (0.5)

ANSWER 1.12

a. LOWER-THAN (+0.5)

b. LOWER-THAN (+0.5)

c. HIGHER-THAN (+0.5)

d. LOWER-THAN (+0.5)

Reference(s) 1.12

1. St. Lucie: Reactor Physics Training Document, Reactor Physics, pp. 7.7-9 - 7.7-10.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.13

Listed below are six (6) radioactive elements which might be found in the RCS water. List those which would not indicate a leak through the fuel cladding. (1.0)

I^{131}
I^{135}
Xe^{133}
Co^{60}
Kr^{85}
Fe^{55}

ANSWER 1.13

Co^{60} (+0.5)
Fe^{55} (+0.5)

Reference(s) 1.13

1. St. Lucie: Off-Normal Operating Procedure, 1-1110030, Off-Normal Operation of the Letdown Monitor, Rev. 1, p. 1.

2. St. Lucie: Technical Specification, Radioactive Effluents, Section 3/4.11, p. 3/4 11-4.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.14

Answer the parts to this QUESTION by "filling-in the blanks".

a. When an element decays by beta (electron) emission, the new element will have an atomic number that is _____ (-2, -1, 0, +1, +2) and a mass number that is _____ (-2, -1, 0, +1, +2) compared to the original element. (1.0)

b. When an element absorbs a neutron and emits a gamma-ray, the new element will have an atomic number that is _____ (-2, -1, 0, +1, +2) and a mass number that is _____ (-2, -1, 0, +1, +2) compared to the original element. (1.0)

For example, an answer of -2 means that the new element has an atomic/mass number that is 2 less than that of the original element; an answer of 0 means that there is no change in the atomic/mass number.

ANSWER 1.14

a. +1 (+0.5)
0 (+0.5)

b. 0 (+0.5)
+1 (+0.5)

Reference(s) 1.14

1. Generic: Academic Program for Nuclear Power Plant Personnel, Volume II, Physics, General Physics Corporation, pp. 3-16 - 3-19, 3-47 - 3-49.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.15

a. With the steam in the Steam Generator at 540°F, what is the pressure in the Steam Generator? (1.0)

b. With the steam in the Steam Generator at 540°F, a Main-Steam relief valve begins to leak. What is the temperature of the steam just outside of the relief valve? (1.0)

ANSWER 1.15

a. ~~900 ± 50~~ 850 - 970 psia (+1.0)

b. 310 ± 10°F (+1.0)

Reference(s) 1.15

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 31-32.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.16

Answer this QUESTION by "filling-in the blanks" and by providing the answer.

The "steam quality" from a Steam Generator refers to the ratio of the mass of _____ to the mass of _____. "Steam quality" may be expressed in percent by multiplying by 100 and then is referred to as "% quality". What is the relationship between "% moisture" and "% quality"? If the steam leaving the MSR has "20°F of superheat", what is the % quality? (2.0)

ANSWER 1.16

vapor

vapor and liquid

% moisture = 100% - % quality

100%

(+0.5 each)

Reference(s) 1.16

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, p. 19.

-Section 1.0 Continued on Next Page-

Points
Available

QUESTION 1.17

When the Pressurizer pressure is 1000 psia and the RCS coolant in the hot leg is 420°F, by how many degrees is the hot-leg coolant subcooled? Normally, would the cold-leg coolant have an amount of subcooling that is larger or smaller than that of the hot leg? (1.5)

ANSWER 1.17

125°F (+1.0)
larger (+0.5)

Reference(s) 1.17

1. St. Lucie: Thermodynamics and Heat Transfer - Module 4, Thermodynamics, pp. 16-17.

QUESTION 1.18

The withdrawal of a control rod, would usually increase the rod worth of other control rods in the immediate vicinity. Briefly explain. (1.0)

ANSWER 1.18

The withdrawal of the control rod would result in an increase in the neutron flux in the vicinity of the pulled rod. The worth of a rod increases if the neutron flux in its vicinity increases. Hence, the worth of the neighboring rods would increase. (+1.0)

Reference(s) 1.18

1. St. Lucie: Reactor Physics Training Document, Reactor Physics, pp. 7.5-42a - 7.5-43.

-End of Section 1.0-

Points
Available

2.0 PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS (30.0)

QUESTIONS 2.01 through 2.05 are "multiple-choice" questions.

QUESTION 2.01

The Pressurizer-System design is intended to (1.0)

(a.) compensate for volume changes in the RCS for design transients of a 10% power/min ramp or a 5% power step.

(b.) provide sufficient steam volume to prevent the water level from reaching the relief-valve nozzles following a reactor trip.

(c.) provide a small enough water volume to minimize the pressure buildup in the containment following a LOCA.

(d.) provide sufficient water level to prevent draining the Pressurizer following a load-reject incident.

ANSWER 2.01

(c.) **(+1.0)**

Reference(s) 2.01

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 1 of 2, Section 1, 1982, p. i.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.02

The Shutdown Cooling (SDC) heat exchangers are used to remove heat during cooldown (1.0)

(a.) if the pressure in the Pressurizer is ≤ 1500 psia and the RCS temperature is ≤ 500°F.

(b.) if the CCW inlet temperature is ≤ 55°F.

(c.) with the cooldown rate controlled by throttling the SDC return valves to the LPSI headers.

(d.) with the cooldown rate controlled by throttling the LPSI flow-control valves which are in parallel with the SDC heat exchangers.

ANSWER 2.02

(c.) **(+1.0)** ~~(d.)~~

Reference(s) 2.02

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, SD24-Rev.1-20.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.03

The Reactor Cavity Cooling System consists of two (2) full-capacity fans with (1.0)

(a.) the operating requirement (ONOP 2000030) to be at ≤ 50% power with the loss of one (1) reactor-cavity cooling fan.

(b.) the fan in standby started automatically on a CIAS.

(c.) the fan in standby started automatically after a 10-second delay on LO flow in the operating fan.

(d.) the fan in operation restarted automatically after a loss of off-site power as demanded by the D/G shutdown sequencer.

ANSWER 2.03

(d.) **(+1.0)**

Reference(s) 2.03

1. St. Lucie: Primary Systems, Book 1, Training Department, Reactor Vessel and Internals, Fuel and Reactor Core, pp. SD2-Rev.1-7 - 1-8.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.05

The A and B trains of the 125 VDC System are normally lined-up such that (1.0)

(a.) the C train is powered from either of the A or B buses via the swing bus AB in Unit 2.

(b.) the swing bus AB is powered from the A-side train in Unit 1.

(c.) the battery charger AB is connected to the A-side train in Unit 2.

(d.) the swing bus AB is powered from the A-side train in Unit 2.

ANSWER 2.05

(d.) **(+1.0)**

Reference(s) 2.05

1. St. Lucie: Electrical Systems, Book 7, Training Department, 120 VAC Instrument and 125 VDC Distribution System, p. SD145-Rev.0-7 and Figure 1.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.06

Answer the parts of this QUESTION concerning the Containment Cooling System by "filling-in the blanks".

a. Upon the receipt of a SIAS, _____ (1, 2, 3, or 4) containment-cooling fans should START in _____ (SLOW, FAST, or NORMAL) speed at Unit 1 while _____ (1, 2, 3, or 4) containment-cooling fans should START in _____ (SLOW, FAST, or NORMAL) speed at Unit 2. (1.0)

b. Water from the _____ System is supplied to the cooling coils of the containment-cooling fan coolers through motor-operated supply and return valves which should _____ (OPEN, CLOSE, or STAY-THE-SAME) on a CIS. At Unit 1 there are _____ motor-operated supply valves while at Unit 2 there are _____. (1.0)

ANSWER 2.06

a. 4 or 1
NORMAL
4 or 1
SLOW

(+0.25 each)

b. CCW
STAY-THE-SAME
2
4

(+0.25 each)

Reference(s) 2.06

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 1 of 2, Section 8, 1982, p. 3 of 5.

2. St. Lucie: Electrical Systems, Book 7, Training Department, Containment Ventilation System, pp. SD29-Rev.0-8 - 0.9.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.07

Penetrations are provided in the four (4) cold legs of the RCS for sensors, piping connections, etc. Below is a list of penetrations that may or may not be provided in the cold legs. Under the headings of Loop 1A1, Loop 1A2, Loop 1B1, and Loop 1B2, specify the penetrations from the list that belong to the respective loops. 3.4 (~~3.5~~)

shutdown-cooling inlet
shutdown-cooling outlet
safety-injection inlet
Pressurizer spray outlet
charging inlet
letdown outlet
penetration for three (3) temperature sensors
penetration for five (5) temperature sensors
surge line

Loop 1A1

Loop 1A2

Loop 1B1

Loop 1B2

-Section 2.0 Continued on Next Page-

Points
Available

ANSWER 2.07

Loop 1A1

shutdown-cooling inlet
safety-injection inlet
penetration for 3 TEs

(+0.2 each)

Loop 1A2

shutdown-cooling inlet
safety-injection inlet
penetrations for 3 TEs
charging inlet

(+0.2 each)

Loop 1B1

shutdown-cooling inlet
safety-injection inlet
penetrations for 3 TEs
Pressurizer spray outlet
charging inlet
letdown outlet

(+0.2 each)

Loop 1B2

shutdown-cooling inlet
safety-injection inlet
penetration for 3 TEs
Pressurizer spray outlet

(+0.2 each)

Reference(s) 2.07

1. St. Lucie: Primary Systems, Book 1, Training Department, Reactor Coolant System, Figure 4, Rev. 1.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.08

Below is a list of statements/facts referring to the HPSI Systems at St. Lucie 1 and 2. For each statement/fact, list UNIT 1, UNIT 2, UNIT 1 and 2, or NEITHER, thereby indicating the Unit(s) for which the statement/fact is correct. (3.0)

a. For normal system and power-source alignment, all three (3) HPSI pumps are OPERABLE with suction and discharge valves OPEN.

b. For normal system and power-source alignment, two (2) and only two (2) HPSI pumps START upon receipt of a SIAS.

c. The HPSI pumps are sized such that one (1) pump could deliver saturated water at a rate sufficient to maintain the core flooded and match decay heat boil-off at the time the ECCS switches to the recirculation mode, not less than 20 minutes after the LOCA.

d. The refueling water tank (RWT) is designed to provide a reservoir of borated water for the injection mode. The tank is maintained at 200 psig with a nitrogen cover gas.

e. For normal system and power-source alignment, with a SIAS and with a RCS pressure of 1000 psig, HPSI pumps A and B would be providing water to the RCS.

f. For normal system and power-source alignment, a SIAS would OPEN the four (4) header-isolation valves connecting pump A and the injection lines. Four (4) other valves would operate in a similar manner for pump B.

ANSWER 2.08

a. Unit 1

b. Units 1 and 2

c. Units 1 and 2

d. Neither

e. ~~Unit 2~~ Units 1 & 2

-Section 2.0 Continued on Next Page-

Points
Available

ANSWER 2.08 (cont)

f. Units 1 and 2

(+0.5 each)

Reference(s) 2.08

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, pp. SD24-Rev.1-13 - 1-16.

QUESTION 2.09

Below is a list of statements/facts referring to the LPSI Systems at St. Lucie 1 and 2. For each statement/fact, list UNIT 1, UNIT 2, UNIT 1 and 2, or NEITHER, thereby indicating the Unit(s) for which the statement/fact is correct. (3.0)

a. The LPSI pumps are single-stage centrifugal pumps that have a minimum run-out flowrate of > 4000 gpm.

b. A portion of the LPSI-pump discharge flow is cooled by CCW and is recirculated to the pump-shaft seals to help extend seal life.

c. The discharge flow from the two (2) LPSI pumps combines and then flows through an air-operated flow-control valve into the LPSI low-pressure header.

d. The flowrate into each of the four (4) injection legs is individually measured by a flowrate sensor.

e. The LPSI discharge-headers connected to pump A and to pump B are protected against overpressurization by two (2) relief valves, one (1) for each pump header.

f. The LPSI System can be aligned to provide flow to the two (2) hot-leg injection lines.

-Section 2.0 Continued on Next Page-

Points
Available

ANSWER 2.09

a. Units 1 and 2

b. Unit 1

c. Unit 1

d. ~~Unit 2~~ Units 1 & 2

e. Unit 2

f. Unit 1

(+0.5 each)

Reference(s) 2.09

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, pp. SD24-Rev.1-16 - 1-18.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.10

Figure 2.10 (QUESTION) shows the Containment Spray System for Unit 2. Answer the following parts of this QUESTION, all of which pertain to the Containment Spray Systems.

a. Upon initiation of a CSAS-A and B, list the responses of the Containment Spray System for Unit 2 (pumps starts and stops, valve changes,...). (1.0)

b. Upon initiation of a RAS-A and B, list the responses of the Containment Spray System for Unit 2. (1.0)

c. For the injection mode at Unit 2, each containment spray pump is designed for ____ (± 500) gpm ~~against a total dynamic head of ___ (± 50) ft,~~ with a discharge pressure of ___ (± 50) psig. (1.5)

d. At Unit 2, the hydrazine system is sized such that (without replenishment) the hydrazine solution could be injected into the containment for about one (1) ____ (hour, day, week). Flow of the hydrazine solution would be automatically stopped by a signal from _____ _____. (1.5)

-Section 2.0 Continued on Next Page-

SIMPLIFIED DRAWING OF UNIT 2 CONTAINMENT SPRAY SYSTEM

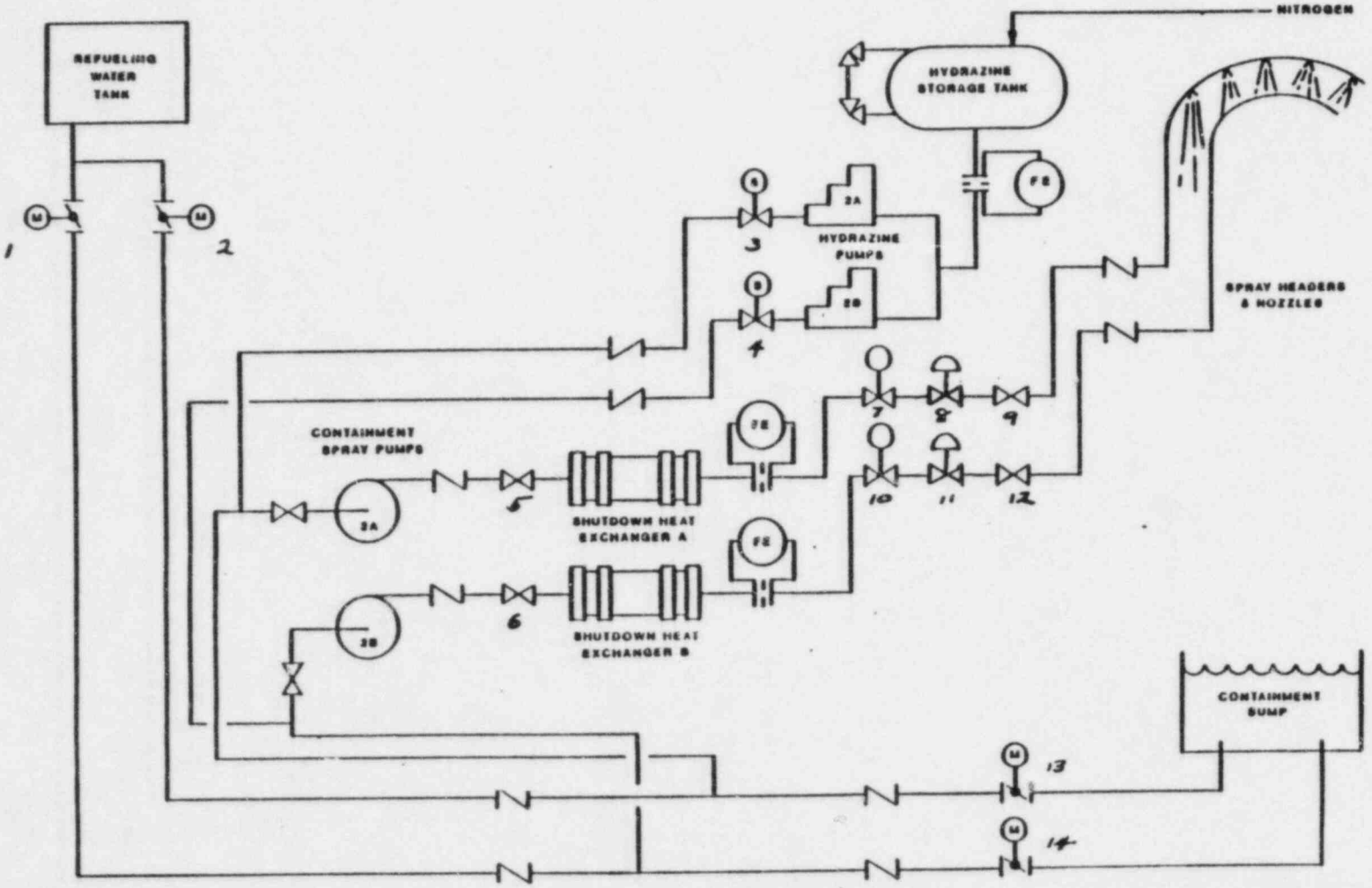


FIGURE 2.10 (QUESTION)

-Section 2.0 Continued on Next Page-

Points
Available

ANSWER 2.10

a. containment spray pumps 2A, 2B START
hydrazine pumps 2A, 2B START
valves ~~5, 6~~ 2, 1 OPEN
valves 3, 4 OPEN

(+0.25 each per-train answer)

b. valves ~~5, 6~~ 13, 14 OPEN
valves ~~7, 8~~ 1, 2 CLOSE

(+0.5 each per-train answer)

c. 2700 ± 500 gpm
~~470 ± 50 ft~~ delete
200 ± 50 psig

(+0.~~5~~ 75 each)

d. hour **(+0.5)** or day
a LO-level switch on the hydrazine storage tank. **(+1.0)**

Reference(s) 2.10

1. St. Lucie: Primary Systems, Book 2, Training Department, Safety Injection System and Containment Heat Removal System, pp. SD24-Rev.1-20 - 1-25.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.11

Answer TRUE or FALSE to each part of this QUESTION concerning the Main-Steam System.

a. Both Units 1 and 2 have two (2) manual/electric atmospheric dump valves per Main-Steam header which together allow removal of core decay heat equivalent to 4% power. (0.5)

b. Only Unit 1 has Main-Steam check valves to prevent backflow from the other steam generator. (0.5)

c. At Unit 2 the Main-Steam Isolation Valves (MSIVs) fail OPEN on loss of electric power to the air solenoids but fail CLOSED on loss of air supply. (0.5)

d. Sixteen (16) safety valves for over-pressure protection are associated with the Main-Steam System at Unit 1 and at Unit 2. (0.5)

ANSWER 2.11

a. FALSE

b. TRUE

c. TRUE

d. TRUE

(+0.5 each)

Reference(s) 2.11

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 1 of 2, Section 13, 1982, pp. 1 - 6 of 6.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.12

The following parts of this QUESTION refer to the Component Cooling Water (CCW) Systems for Units 1 and 2.

a. List the seven (7) components that normally receive CCW from header B at Unit 1 (for example, cavity spray pump 1C, ...). (1.4)

b. List nine (~~8~~ 6) of the eleven (~~11~~ 8) components that receive CCW from the nonessential header N during normal operation. (1.8)

c. List one (1) component that normally receives CCW from header B at Unit 2 but does not receive CCW from this header at Unit 1. (0.2)

d. Provide the information indicated by the blanks. At Unit 2, there are _____ air-operated valves that are used to line up the N header to either the A or B header, which CLOSE on a SIAS. In addition, these valves will automatically CLOSE on a _____ signal. (0.5)

ANSWER 2.12

a. shutdown heat exchanger 1B
containment fan cooler 1C
containment fan cooler 1D
HPSI pump 1B
HPSI pump 1C
LPSI pump 1B
containment spray pump 1B

(+0.2 each)

b. ~~fuel-pool heat exchanger~~
sample-system heat exchangers
boric-acid concentrators
waste concentrator
waste-gas compressors
letdown heat exchanger
control-element drive-mechanism air coolers
reactor coolant pumps and motors
blowdown radiation monitoring and sampling
~~containment air compresso~~rs

-Section 2.0 Continued on Next Page-

Points
Available

ANSWER 2.12 (cont)

~~quench tank cooling units~~
.3
(+0.~~1~~ each, +1.8 max)

c. control room A/C 3A, 3B, 3C
fuel pool heat exchanger

(+0.2 each, +0.2 max)

d. 4
LO surge tank level

(+0.25 each)

Reference(s) 2.12

1. St. Lucie: Primary Systems, Book 2, Training Department, Component Cooling Water System, pp. SD40-Rev.0-4 - 0-7.

-Section 2.0 Continued on Next Page-

Points
Available

QUESTION 2.13

Describe the Main Condenser by choosing the correct responses from the "list of responses" given below.

a. Openings are provided in the Main Condenser for the Low-Pressure Heaters. These heaters are located in the ____ _____. There are ___ in each shell for a total of ___. The source of the heat is _____. The fluid that is being heated is the feedwater from the discharge of the _____. (1.5)

b. An air-ejector system is used to remove noncondensable gases and air from the Main Condenser during plant startup, cooldown and normal operation. Unit 2 uses ___ _____ _____ and ___ _____. (1.0)

list of responses

1
2
3
4
hot well
discharge tunnel
neck of the condenser shells
extraction steam from the low-pressure turbine
extraction steam from the high-pressure turbine
hogging ejectors
steam-jet air ejectors
third-stage feedwater pump
condensate pumps
circ water pumps

ANSWER 2.13

a. neck of the condenser shells
2
4
extraction steam from the low pressure turbine
condensate pumps

(+0.3 each)

-Section 2.0 Continued on Next Page-

Points
Available

b. 2 hogging ejectors
2 steam-jet ejectors

(+0.5 each)

Reference(s) 2.13

1. St. Lucie: Secondary Systems, Book 4, Training Department, Condenser and Circulation Water System, p. SD123-Rev.0-7.

-End of Section 2.0-

Points
Available

3.0 INSTRUMENTS AND CONTROLS (30.0)

QUESTIONS 3.01 through 3.04 are "multiple-choice" questions.

QUESTION 3.01

The REACTOR COOLANT PUMPS SEAL TUBE LEAK alarm is activated (1.0)

(a.) by a HI ΔT between the RC at the inlet and at the outlet of the shaft-seal heat exchanger.

(b.) by a HI ΔT between the CCW at the inlet and at the outlet of the shaft-seal heat exchanger.

(c.) if there is a HI RC temperature at the outlet of the shaft-seal heat exchanger AND if a 60-second delay has occurred since the actuation of the HI temperature signal.

(d.) if the seal cooler CCW outlet-valve is CLOSED.

ANSWER 3.01

(b.) **(+1.0)**

Reference(s) 3.01

1. St. Lucie: Primary Systems, Book 1, Training Department, Reactor Coolant Pumps, p. SD8-Rev.1-8.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.02

The blowdown line of Steam Generator (S/G) 1A has (1.0)

(a.) an air-actuated containment-isolation valve inside containment which is CLOSED by a CIAS or by a blowdown HI-radiation control signal.

(b.) a temperature-measuring element and two (2) pressure switches which are successively located downstream of a containment-isolation valve.

(c.) a flowrate sensor which controls the pressure-control valve located just upstream of the flowrate sensor.

(d.) a flowrate sensor which controls both the inside and outside of containment isolation valves to provide protection in the event of a high-energy line break.

ANSWER 3.02

(b.) (+1.0)

Reference(s) 3.02

1. St. Lucie: Secondary Systems, Book 4, Training Department, Steam Generator Blowdown, pp. SD102-Rev.1-6 - 1-9.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.03

Normal hotwell-level control is provided by four (4) makeup valves and one (1) reject regulator in which (1.0)

(a.) the makeup valves are sequenced OPEN by hotwell-level switches, the first at 1 in. below normal level, the second at 2 in., the third at 3 in., and the fourth at 4 in. below normal level.

(b.) the reject regulator is OPENED at 12 in. below normal level.

(c.) the reject regulator is OPENED to drain condensate into the line that taps off the outlet of the gland-steam condenser.

• (d.) all four (4) makeup valves fail OPEN on loss of instrument air.

ANSWER 3.03

(a.) (+1.0)

Reference(s) 3.03

1. St. Lucie: Secondary Systems, Book 4, Training Department, Condenser and Circulating Water System, pp. SD123-Rev.0.9 - 0.11.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.04

Which statement correctly describes the operation and control of the Main Feedwater Pumps? (1.0)

(a.) If both Main Feedwater Pumps were in operation with the total feedwater flowrate at 40% of full-power flowrate and if one (1) of the two (2) operating condensate pumps tripped, then one (1) feedwater pump should trip.

(b.) If the suction pressure for an operating Main Feedwater Pump has falled to 300 psig and a 5 second delay has occurred, the feedwater pump should trip.

(c.) If the flowrate of an operating Main Feedwater Pump has reached the LO-LO setpoint and a ≥ 30-second delay has occurred, the feedwater pump should trip.

(d.) If the lube-oil pressure of an operating Main Feedwater Pump has dropped to 6 psig and a ≥ 10-second delay has occurred, the feedwater pump should trip.

ANSWER 3.04

(d.) **(+1.0)** or (c.)

Reference(s) 3.04

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 2 of 2, Section 33, 1982, p. 22.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.05

Answer this QUESTION concerning the Intake Cooling Water (ICW) Pumps by "filling-in the blanks".

a. The three (3) ICW pumps are centrifugal pumps each with a capacity of _____ gpm (± 20%) with a discharge pressure of _____ psig (± 20%). (1.0)

b. Upon loss of off-site power, the system is automatically restarted and loaded onto the emergency diesel generators. If all three (3) ICW pumps are available, _____ pumps are started. The interruption in ICW pump operation should be less than _____ (± 20%). During operation in which the ICW pump motors are powered from the emergency diesel generators, the bearing lube-water supply is _____. (1.5)

c. Local instrumentation is available for monitoring ICW pump _____ and for monitoring ICW pump _____. At Unit 2 only, there is local instrumentation for monitoring ICW pump _____. (1.5)

ANSWER 3.05

a. 14,500 ± 2900 gpm (+0.5)
~~56 ± 11 psig~~ (+0.5) 40 to 67 psig

b. 2 (+0.5)
~~30 ± 6 seconds~~ (+0.5) 10 to 40 [illegible]
the discharge of the ICW pumps (+0.5)

c. discharge pressure (+0.5)
lube water flowrate (+0.5)
lube water pressure (+0.5)

Reference(s) 3.05

1. St. Lucie: Secondary Systems, Book 4, Training Department, Intake Cooling Water System, pp. SD165-Rev.0-8 - 0-9.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.06

The Excore Nuclear Instrumentation System (NIS) is designed such that the neutron flux is continually monitored from the source range to _____ % of full power. At Unit 1 there are _____ NIS channels. At Unit 2 there are _____ NIS channels. Of these NIS channels at Unit 1, ____4____ channels provide a wide-range logarithmic (log) indication. At Unit 2, there are ____6____ log channels. Each log channel at Unit 1 utilizes a _____ detector assembly. At Unit 1, _____ of these log channels can provide the audio signal for the 12 remote speakers located in containment. Each log safety channel at Unit 2 utilizes a _____ detector assembly. At Unit 2, the audio signal is obtained from the _____ channel which utilizes a _____ detector assembly. (3.0)

ANSWER 3.06

200		200
10		12
14	or	14
4		6
6		6
fission chamber		fission chamber
4 or 2/2		4 or 2/2
fission		fission
log startup		startup
BF_3 proportional counter		BF_3

(+0.3 each)

Reference(s) 3.06

1. St. Lucie: Excore Nuclear Instrumentation, Book 6, Training Department, pp. SD4-Rev.1-4 - 1-50.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.07

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, if any, in the letdown flowrate should occur and/or what alarms and actions, if any, should be taken by the CVCS as the Pressurizer level slowly decreases to the levels indicated below? Include any differences between Units 1 and 2.

a. -1% (0.5)

b. -2% (0.5)

c. -3% (0.5)

d. -4% (0.5)

e. -5% (0.5)

ANSWER 3.07

a. At -1% the letdown flowrate should have decreased to almost 29 gpm. **(+0.5)**

b. There is no change between -1% and -2%. **(+0.5)**

c. At -3% (at -2.5%) a backup charging pump should have started. **(+0.5)**

d. By -4% a second backup charging pump should have started at Unit 1, but not at Unit 2. **(+0.5)**

e. At -5% a LO-level alarm occurs and backup START signal should be sent to all of the charging pumps. **(+0.5)**

Reference(s) 3.07

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 2 of 2, Section 27, 1982, p. 8 of 11.

2. St. Lucie: Secondary Systems, Book 5, Training Department, Reactor Regulating System, pp. SD9-Rev.1-55 and Figure 34.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.09

Answer the following parts of this QUESTION, all of which pertain to the Qualified Safety Parameter Display System (QSPDS).

a. The instrument sensor package for Inadequate Core Cooling (ICC) detection provides the reactor operator a continuous indication of the progression leading to and away from ICC. The progression is divided into three (3) conditions based on physical processes occurring within the reactor vessel. The three (3) conditions are

falling coolant inventory
loss of fluid subcooling
increasing core-exit temperature

Place a #1 next to the condition that is least severe. Place a #3 next to the condition that is the most severe, that is of greatest concern. (1.0)

b. Figure 3.09 (QUESTION) is a sketch of a HJTC used in the QSPDS. With the use of the figure, provide a brief indication of the operational principle of an HJTC in detecting a decreasing water level. (1.0)

c. The QSPDS determines three (3) Saturation Margin Monitoring (SMM) values. List the three (3) margins and the associated temperature sensors that are utilized. (1.5)

d. What signal is used to provide the saturation temperature? (0.5)

ANSWER 3.09

a. loss of fluid subcooling #1
falling coolant inventory
increasing core-exit temperature #3

(+1.0)

-Section 3.0 Continued on Next Page-

Points
Available

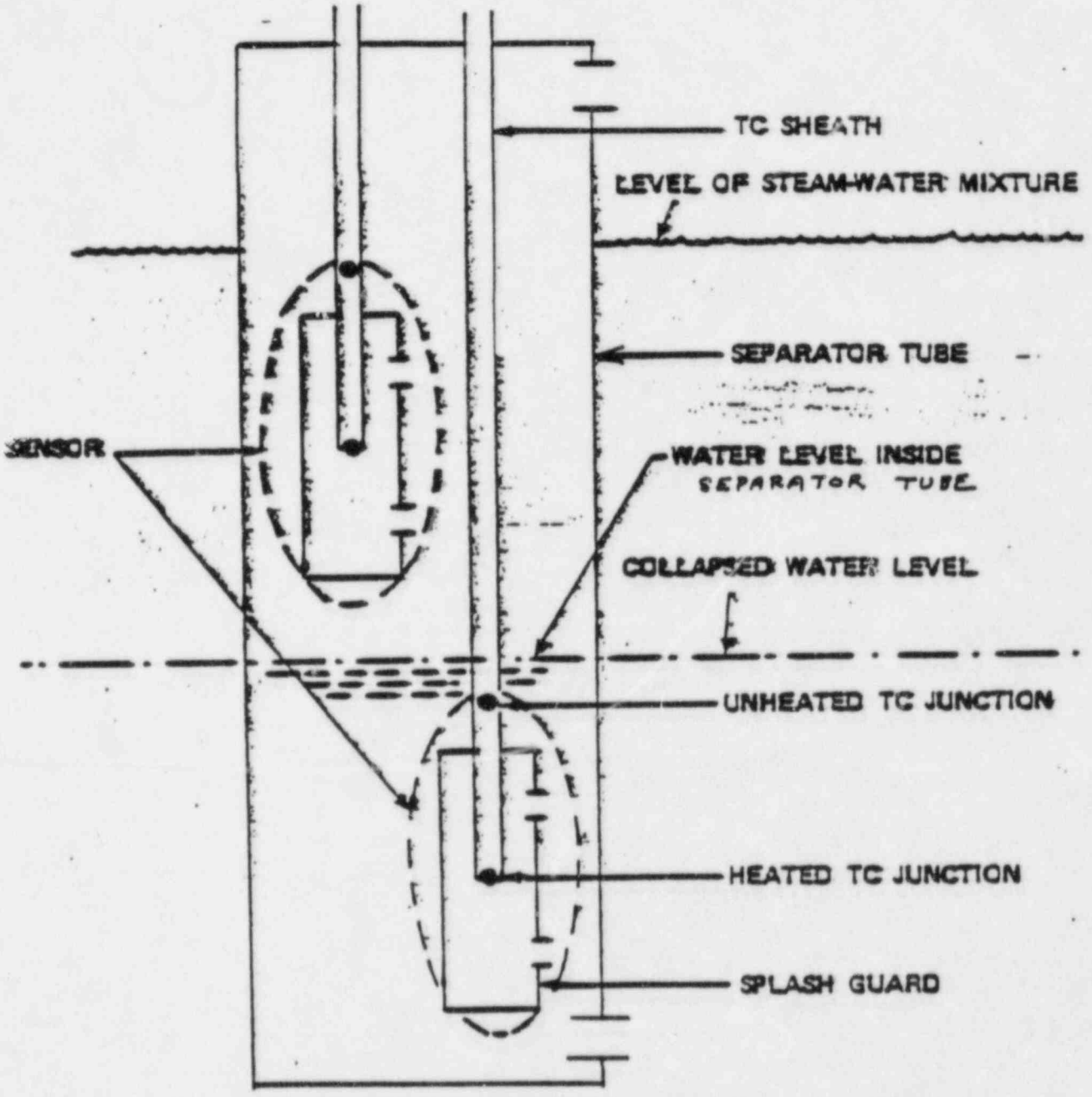


Figure 3.09 (QUESTION)

-Section 3.0 Continued on Next Page-

Points
Available

ANSWER 3.09 (cont)

b. The sensor consists of two (2) TCs one of which is heated. If the heated TC is in water, the heat is sufficiently dissipated that the two (2) TCs have equal outputs; if not, there is a difference in outputs. So when the calm water level drops below the heated TC level, the HJTC provides an indication. **(+1.0)**

c. RCS saturation margin - max of RTDs in the hot and cold legs. **(+0.5)**

upper-head saturation margin - max of the top three (3) UHJTCs **(+0.5)**

CET saturation margin - max CET **(+0.5)**

d. Pressurizer pressure **(+0.5)**

Reference(s) 3.09

1. St. Lucie: Control Systems, Book 5, Training Department, Computer Monitoring Systems QSPDS Handout, pp. 1-18.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.10

Answer TRUE or FALSE to the following statements that refer to the instrumentation at Unit 2.

a. One of the purposes of the in-core instrumentation system is to provide an accurate source-range neutron detection system for use during reactor startups. (0.5)

b. There are more than 100 In-Core Instrumentation (ICI) detector assemblies. (0.5)

c. The Heated-Junction Thermocouple (HJTC) system measures the reactor-coolant liquid inventory above the fuel-alignment plate. (0.5)

d. In each of the ICI detector assemblies there are four (4) self-powered rhodium neutron detectors which measure the neutron-flux distribution above the fuel-alignment plate. (0.5)

ANSWER 3.10

a. FALSE

b. FALSE

c. TRUE

d. FALSE

(+0.5 each)

Reference(s) 3.10

1. St. Lucie: Unit 1/2 Lesson Plans and System Descriptions, Book 2 of 2, Section 35, 1982, p. 1.9B-0 - 1.9B-20.

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.12

Refer to Figure 3.12 (QUESTION) which shows a typical level-measuring system for such closed tanks as the Pressurizer and the Steam Generator. Answer the following parts to this QUESTION by choosing the correct response, by "filling-in the blanks", or by completing the sentence.

a. The output of the D/P cell is $P_R - P_V$. This output is equal to the water density times _____. (h_1, h_2, h_3, h_4, or h_5) (0.5)

b. If the water level decreased, how would the output of the D/P cell ($P_R - P_V$) change? (INCREASE, DECREASE, or STAY-THE-SAME) (0.5)

c. If the reference leg broke and some of the water in the reference leg drained out, the output of the D/P cell, ($P_R - P_V$) would _____ (INCREASE, DECREASE, or STAY-THE-SAME) and the indicated level would _____ (INCREASE, DECREASE, or STAY-THE-SAME). (1.0)

d. Increasing containment temperature from a line break (not from the tank or its level-measuring system) would cause the indicated tank level to _____. (INCREASE DECREASE, or STAY-THE-SAME) (0.5)

ANSWER 3.12

a. h_2 **(+0.5)**

b. INCREASE **(+0.5)**

c. DECREASE **(+0.5)**
INCREASE **(+0.5)**

d. INCREASE **(+0.5)**

-Section 3.0 Continued on Next Page-

Points
Available

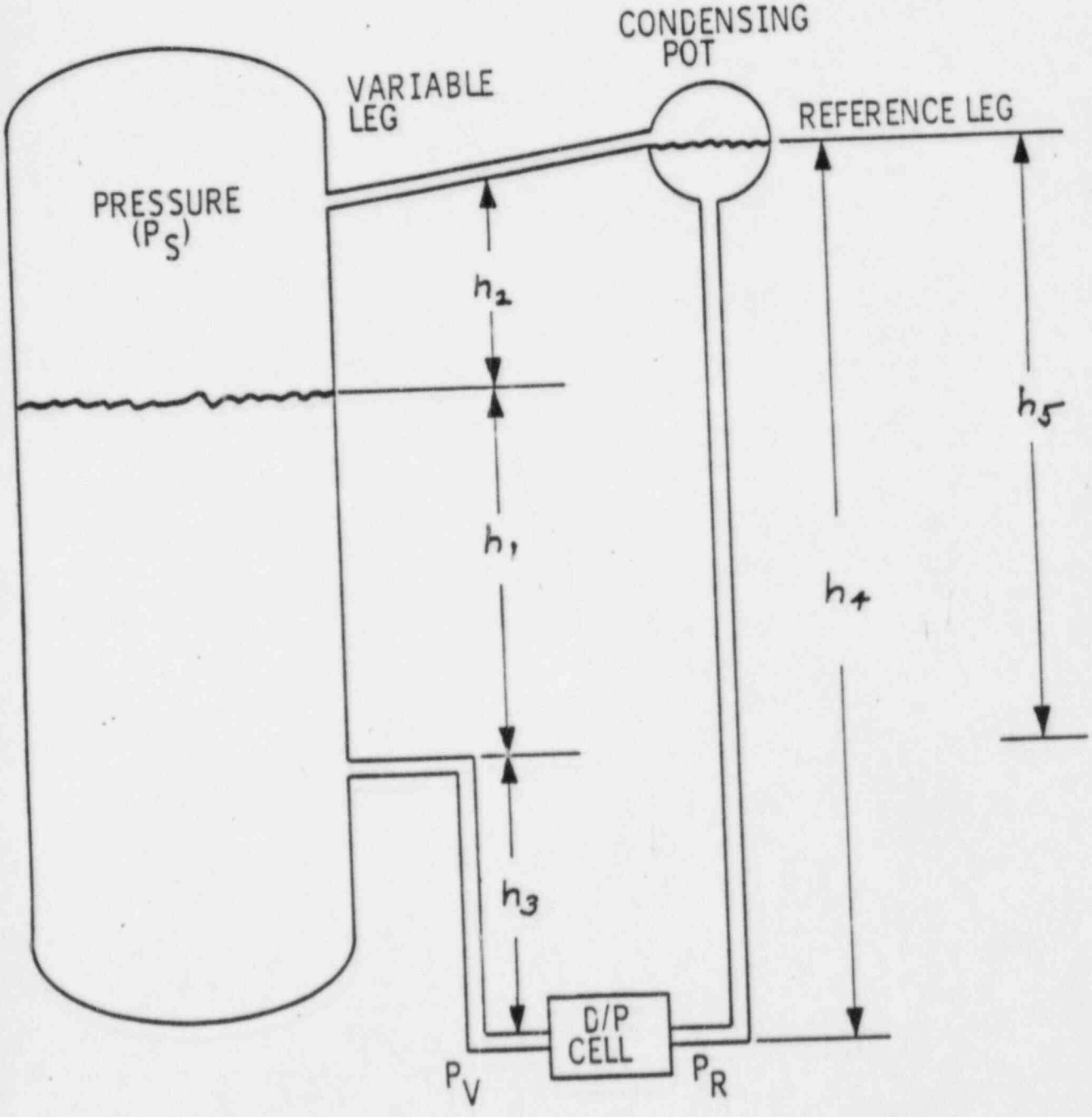


Figure 3.12 (QUESTION)

-Section 3.0 Continued on Next Page-

Points
Available

QUESTION 3.14

The startup-rate (SUR) signal is used by the Reactor Protection System (RPS). Specify the pre-trip setpoint, the trip setpoint, and the power range (in % of full power) during which the SUR can trip the Unit 1 reactor. (2.0)

ANSWER 3.14

1.3 ± 0.1 dpm
2.49 ± 0.1 dpm

10^{-4} to 15%

(+0.5 each)

Reference(s) 3.14

1. St. Lucie: Control Systems, Book 6, Training Department, Excore Nuclear Instrumentation, pp. SD4-Rev.1-17 - 18.

-End of Section 3.0-

Points
Available

4.0 PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL (30.0)

QUESTIONS 4.01 through 4.07 are "multiple-choice" questions.

QUESTION 4.01

After the receipt of a CIAS at Unit 1 there should be (1.0)

(a.) one (1) containment purge exhaust fan ON.

(b.) two (2) shield-building exhaust fans ON.

(c.) two (2) Diesel-Generators ON and LOADED.

(d.) four (4) control-room ventilation isolation valves OPEN.

ANSWER 4.01

(b.) **(+1.0)**

Reference(s) 4.01

1. St. Lucie: Emergency Operating Procedure, 1-EOP-03, Loss of Coolant Accident, pp. 37 - 38.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.02

Certain logs are required reading at shift turnover. Select the required reading for the RCO (1.0)

(a.) NWE Log
Night Order Log
Equipment Out of Service Log

(b.) Turbine Operator Log
Nuclear Operator Log
Control Center Log

(c.) Control Center Log
Equipment Out of Service Log
NWE Log

(d.) Control Center Log
Equipment Out of Service Log
Night Order Log

(e.) NWE Log
Turbine Operator Log
Control Center Log

ANSWER 4.02

(d.) **(+1.0)**

Reference(s) 4.02

1. St. Lucie: Administrative Procedure, 0010120, Duties and Responsibilities of Operators on Shift, p. 10.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.03

While operating at 100% of full power at Unit 1, all four (4) Reactor Coolant Pumps (RCPs) are tripped. Fifteen (15) minutes after tripping the RCPs, verification of natural-circulation flow cannot be verified if (1.0)

(a.) the loop ΔT is less than the full-power ΔT.

(b.) the cold-leg temperature, T_C, is constant or decreasing.

(c.) the hot-leg temperature, T_H, is steadily increasing.

(d.) no abnormal temperature difference exists between the T_H RTDs and the core-exit thermocouples (CETs).

ANSWER 4.03

(c.) **(+1.0)**

Reference(s) 4.03

1. St. Lucie: Off-Normal Operating Procedure, 1-0030140, Rev. 29, Blackout Operation, Section 5.10, p. 6.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.04

If a Steam-Generator tube rupture occurs on Unit 1 and if all RCPs are stopped, RCP restart criteria cannot be met if (1.0)

(a.) the CCW has been lost for 4 minutes.

(b.) the RC is 30°F subcooled.

(c.) the Pressurizer level is 40%.

(d.) the unaffected Steam-Generator level is 30% wide range.

ANSWER 4.04

(d.) (+1.0)

Reference(s) 4.04

1. St. Lucie: Emergency Operating Procedure, 1-EOP-04, Steam Generator Tube Rupture, p. 6.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.05

The Unit 1 hydrogen recombiner should always be placed in service when the hydrogen concentration in containment is between (1.0)

(a.) 0.5% and 3.5%

(b.) 1.5% and 3.5%

(c.) 3.5% and 4.0%

(d.) 3.5% and 10.0%

ANSWER 4.05

(a.) **(+1.0)**

Reference(s) 4.05

1. St. Lucie: Emergency Operating Procedure, 1-EOP-03, Loss of Coolant Accident, p. 21.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.06

If an inadvertent SIAS at Unit 1 was received (1.0)

(a.) all four (4) RCPs would automatically trip.

(b.) the CCW to the RCPs would be isolated.

(c.) the HPSI pumps would inject water into the RCS.

(d.) a CSAS would be initiated.

ANSWER 4.06

(b.) **(+1.0)**

Reference(s) 4.06

1. St. Lucie: Emergency Operating Procedures, 1-EOP-03, Loss of Coolant Accident, p. 3.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.07

If the HPSI pumps were running during an excess-steam demand event at Unit 1, the HPSI pumps should not be throttled or stopped if (1.0)

(a.) the RC is 40°F subcooled.

(b.) the Pressurizer level is 20%.

(c.) both Steam-Generator levels are 50%.

(d.) the reactor-vessel level is 60%.

ANSWER 4.07

(b.) (+1.0)

Reference(s) 4.07

1. St. Lucie: Emergency Operating Procedure, 1-EOP-05, Excess Steam Demand, p. 6.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.08

According to Procedure No. 2-003-127 (Reactor Plant Cooldown - Hot Standby to Cold Shutdown) at Unit 2,

a. what would be the status of the following valves when taking the Pressurizer solid? (MANUAL or AUTO) and (OPEN, CLOSED, or THROTTLED) (2.0)

1. Pressurizer-level control valves LCV-2110P and LCV-2110Q

2. Letdown pressure-control valve

b. below what temperature may the Pressurizer be taken solid? (0.5)

ANSWER 4.08

a. 1. MANUAL (+0.5), OPEN (+0.5)
2. AUTO (+0.5), THROTTLED (+0.5)

b. 200°F (+0.5)

Reference(s) 4.08

1. St. Lucie: Operating Procedures, 2-0030127, Rev. 15, Reactor Plant Cooldown - Hot Standby to Cold Shutdown, Sections 8.54 - 8.55, p. 13.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.09

What are the IMMEDIATE OPERATOR ACTIONS on a complete loss of off-site electrical power? [Procedure 1-0030140 (Blackout Operation)] (5.0)

ANSWER 4.09

1. Trip Turbine and reactor manually. **(+0.5)**
2. Ensure all CEAs are fully inserted and reactor trip breakers are open. **(+0.5)**
3. Ensure turbine valves are closed. **(+0.5)**
4. Ensure Generator Exciter Supply breaker and Generator breakers are OPEN. **(+0.5)**
5. Place Reheater Control System in MANUAL, the CLOSE TCVs. **(+0.5)**
6. Ensure that Diesel Generators have started and are feeding only emergency buses. **(+0.5)**
7. Open Startup Transformer breakers. **(+0.5)**
8. Reduce T_{avg} to reference setpoint (T_{ref} = 532°F) by manual operation of the Atmospheric Steam Dump valves. **(+0.5)**
9. Isolate S/G blowdown. **(+0.5)**
10. Verify 1C steam-driven AFW Pump has started and has established flow to the S/Gs. If AFW Pumps have started due to the auto start feature, manual control can be taken after the auto actions are completed. **(+0.5)**

Reference(s) 4.09

1. St. Lucie: Off-Normal Operating Procedure, 1-0030140, Rev. 29, Blackout Operation, Section 4.0, p. 4.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.10

List the IMMEDIATE OPERATOR ACTIONS for Control Room Inaccessibility at Unit 2. [Off-Normal Operating Procedure 2-00301341 (Control Room Inaccessibility)] (2.5)

ANSWER 4.10

IMMEDIATE OPERATOR ACTIONS:

1. Manually trip the reactor and turbine prior to leaving the control room, if possible. **(+0.5)**

2. Announce evacuation of the control room over the P.A. system. **(+0.5)**

3. Implement the Emergency Plan **(+0.5)**, as necessary, in accordance with EPIP 3100021E, "Duties and Responsibilities of the Emergency Coordinator".

4. Obtain the Remote Shutdown Room Keybox Master Key **(+0.5)** from the control room key locker.

5. Evacuate all personnel from the control room. **(+0.5)**

Reference(s) 4.10

1. St. Lucie: Off-Normal Operating Procedures, 2-0030141, Revision 13, Control Room Inaccessibility, p. 2.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.11

Answer TRUE or FALSE.

If at 100% of full power at Unit 1, a CEA has dropped into the core, the operator should immediately commence emergency boration in order to reduce power to ≤ 50% within 1 hour. (0.5)

ANSWER 4.11

FALSE **(+0.5)**

Reference(s) 4.11

1. St. Lucie: Off-Normal Operating Procedures, 1-0110030, Revision. 12, CEA Off-Normal Operation, Section 5.4.2a, p. 7.

QUESTION 4.12

Give three (3) control-room indications available to the operator that are indicative of a void in the reactor-vessel head during a natural-circulation cooldown at Unit 1. (1.5)

ANSWER 4.12

1. QSPDS Rx-vessel level-monitoring display indicates < 100% in Rx head region. **(+0.5)**

2. Significant unexpected Pressurizer level increase while operating aux spray, or Pressurizer level decrease while charging to RCS loops. **(+0.5)**

3. If Pressurizer level system in automatic, unanticipated letdown flow greater than charging flow. **(+0.5)**

Reference(s) 4.12

1. St. Lucie: Emergency Procedure, 1-0030140, Rev. 29, Blackout Operation, Section 5.13.4, p. 8.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.13

List the five (5) reasons/situations that require RWPs as specified in Health Physics Procedure, HP-1, "Radiation Work Permits". (2.5)

ANSWER 4.13

1. entry into the reactor containment **(+0.5)**
2. entry into a High Radiation Area **(+0.5)**
3. entry into an Airborne Radiation Area ≥ 25% MPC **(+0.5)**
4. work assignments involving equipment or surfaces contaminated to levels > 10,000 DPM/100 cm^2 **(+0.5)**
5. work assignments involving irradiated fuel **(+0.5)**

Reference(s) 4.13

1. St. Lucie: Health Physics Procedure, HP-1, Radiation Work Permits, p. 1.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.14

Certain limits and precautions are addressed in the Unit 2 Operating Procedure 2-0030124, "Turbine Startup". State the reason for each of the following.

a. Gland steam should be placed in service after the turbine is on the turning gear. (0.5)

b. Gland steam should be placed in service before a vacuum is drawn. (0.5)

c. Steam-header drain valves must be open below 20% load. (0.5)

ANSWER 4.14

a. prevents bowing of the rotor **(+0.5)**

b. prevents seal damage due to pulling in air and dirt across the glands **(+0.5)**

c. minimizes water intrusion into the turbine **(+0.5)**

Reference(s) 4.14

1. St. Lucie: Operating Procedures, 2-0030124, Rev. 12, Turbine Startup - Zero to Full Load, p. 1.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.15

Following a complete loss of off-site power associated with a turbine trip at Unit 1, all loads are shed from the emergency buses except eight (8). List these eight (8) loads. (4.0)

any five (5) of the

ANSWER 4.15

1. Boric-Acid Makeup Pumps
2. Charging Pumps
3. Emergency lighting
4. Class IE power panels
5. RCP oil-lift pumps - "A" pumps only
6. Diesel-fuel oil-transfer pump
7. Motor-operated valves
8. HPSI Pumps

~~(+0.5 each)~~ (+.8 each, +4.0 max)

Reference(s) 4.15

1. St. Lucie: Emergency Procedure, 1-0030140, Rev. 29, Section 3.9, p. 3.

-Section 4.0 Continued on Next Page-

Points
Available

QUESTION 4.16

In the Unit 1 control room, positive indication of leakage of coolant from the RCS to containment or to other systems are provided by equipment which permits continuous monitoring of certain plant parameters and the activity of other systems. List six (6) pieces of equipment; i.e., six (6) different types of equipment; which may alarm and indicate when excessive leakage is present. (3.0)

ANSWER 4.16

1. Containment air particulate monitor
2. Containment radioactive-gas monitor
3. Component cooling liquid monitor
4. Condenser air ejector gas monitor
5. Steam generator liquid sample monitor
6. Plant vent radiation monitor
7. Containment area radiation monitors
8. High-level pressure or temperature in the quench tank
9. High-temperature reactor coolant relief or safety valve discharge line
10. Low level in volume control tank
11. High-level containment sump
12. Low pressurizer level
13. High-level component cooling water surge tank
14. High-level reactor coolant drain tank
15. Safety Relief Valve(s) open alarm - H.11
16. High S1 Loop Header Pressure

(+0.5 each, +3.0 maximum)

Reference(s) 4.16

1. St. Lucie: Off-Normal Operating Procedure, 1-0120031, Excessive Reactor Coolant System Leakage, Rev. 8, Section 4.1, pp. 1, 2.

-End of Section 4.0-

ST. LUCIE PLANT
ADMINISTRATIVE PROCEDURE 0010140, REVISION 1
CONTROL OF OPERATOR AIDS

ATTACHMENT (3)

PLANT PHYSICS CURVE BOOK
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UNIT 1
CYCLE 6

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A.3	Xenon Reactivity - Xenon Worth vs Power	6/5/85
A.4	Xenon Reactivity - Xenon Worth vs Time after Shutdown	6/5/85
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C.4	MTC vs Burnup (HFP)	3/12/84

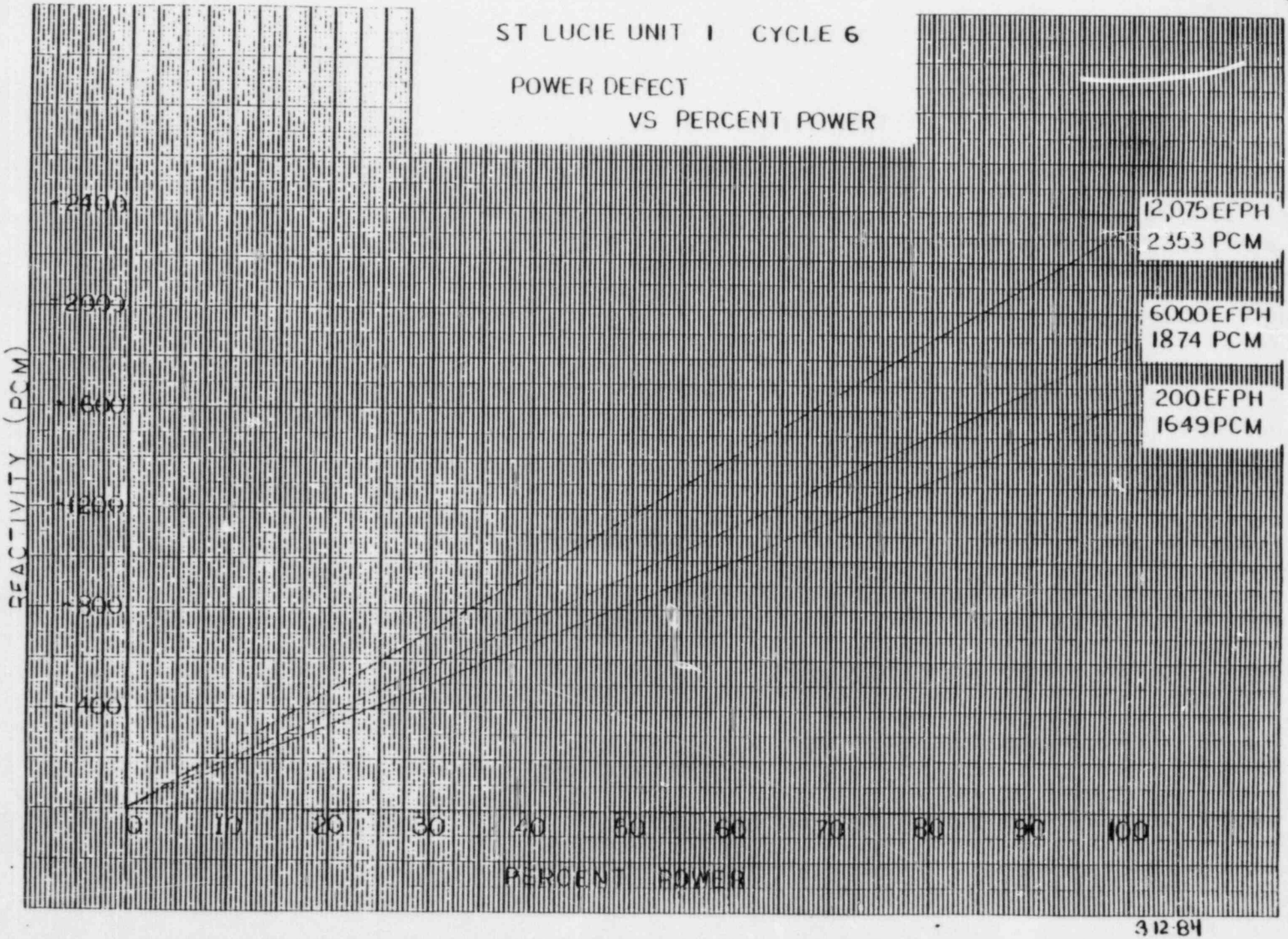
Approved by [signature] Reactor Engineering Supervisor — Date 6/6/85

Approved by [signature] Operations Supervisor — Date 6/6/85

Approved by [signature] Plant Manager, FRG — Date 6/6/85

/R1

FIG. A.1

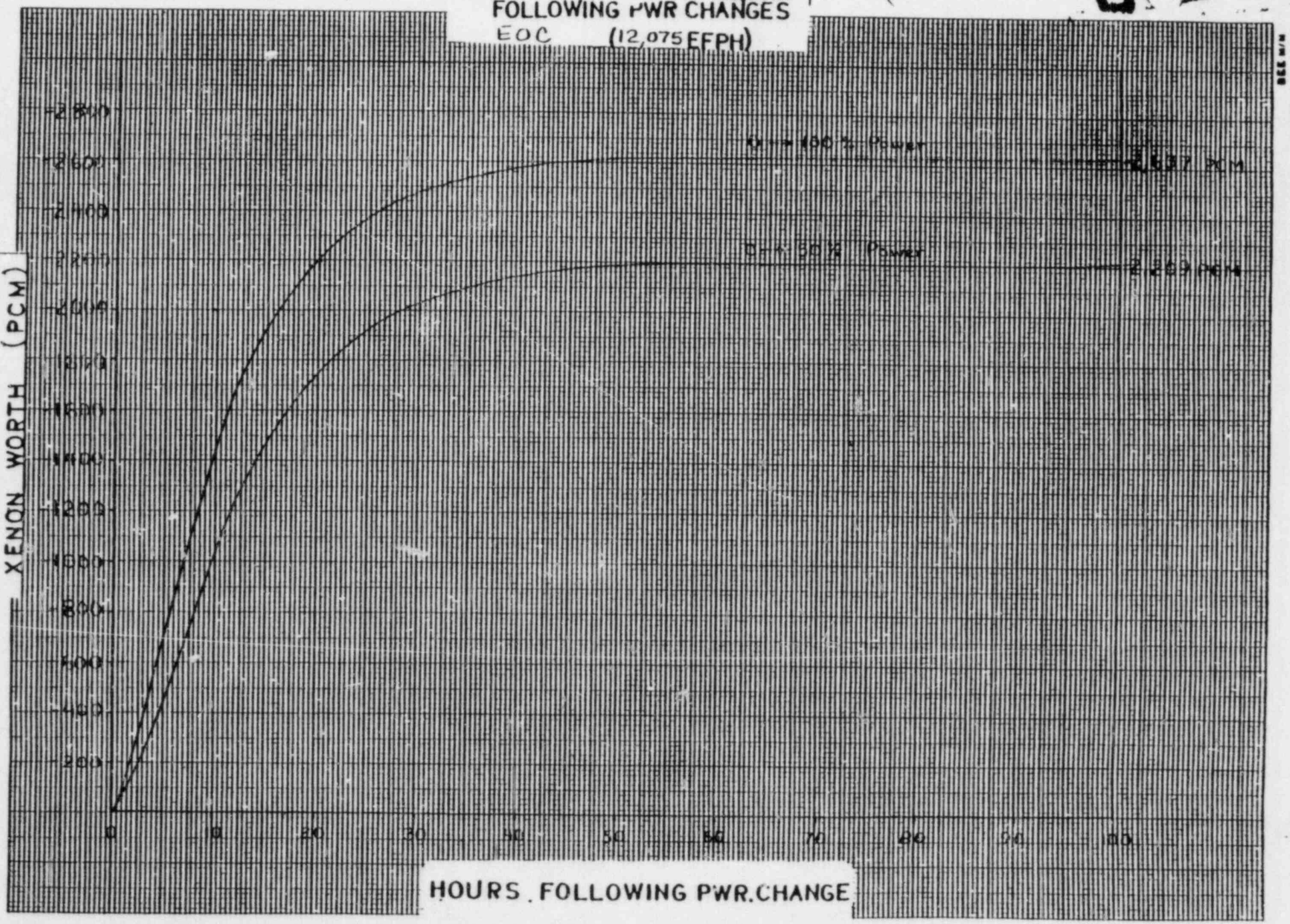

ST LUCIE UNIT 1 CYCLE 6
POWER DEFECT
VS PERCENT POWER
12,075 EFPH
2353 PCM
6000 EFPH
1874 PCM
200 EFPH
1649 PCM
REACTIVITY (PCM)
-2400
-2000
-1600
-1200
-800
-400
0
10
20
30
40
50
60
70
80
90
100
PERCENT POWER

312-84

ST. LU 1 FIG A.2 CYCLE 6

XENON BUILD UP TO EQUIL. FOLLOWING PWR CHANGES

EOC (12,075 EFPH)



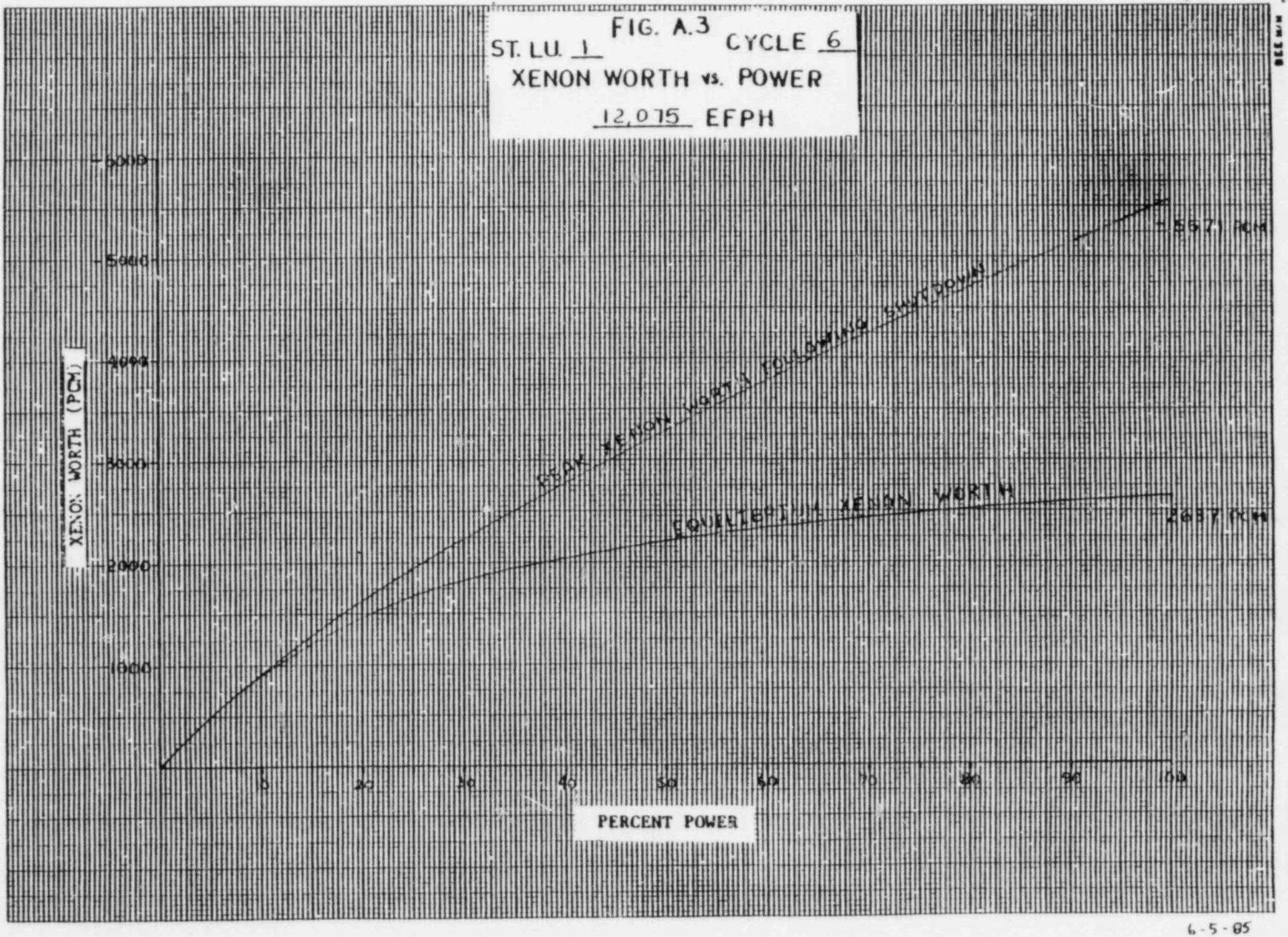
6-5-85

FIG. A.3

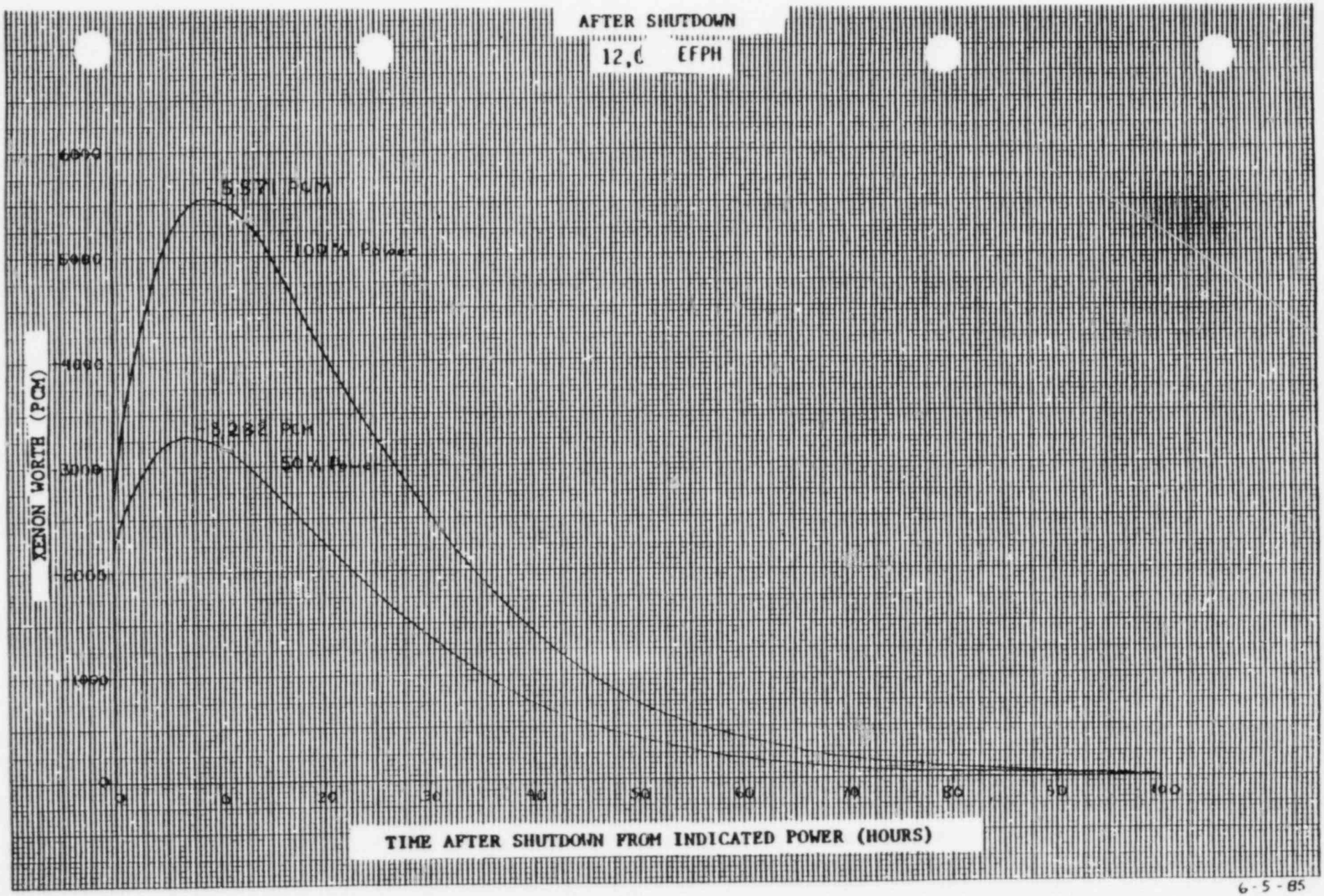
ST. LU. 1 CYCLE 6

XENON WORTH vs. POWER

12,075 EFPH



6-5-85


AFTER SHUTDOWN
12,0 EFPH
XENON WORTH (PCM)
-5371 PCM
100% Power
-3282 PCM
50% Power
TIME AFTER SHUTDOWN FROM INDICATED POWER (HOURS)
6-5-85

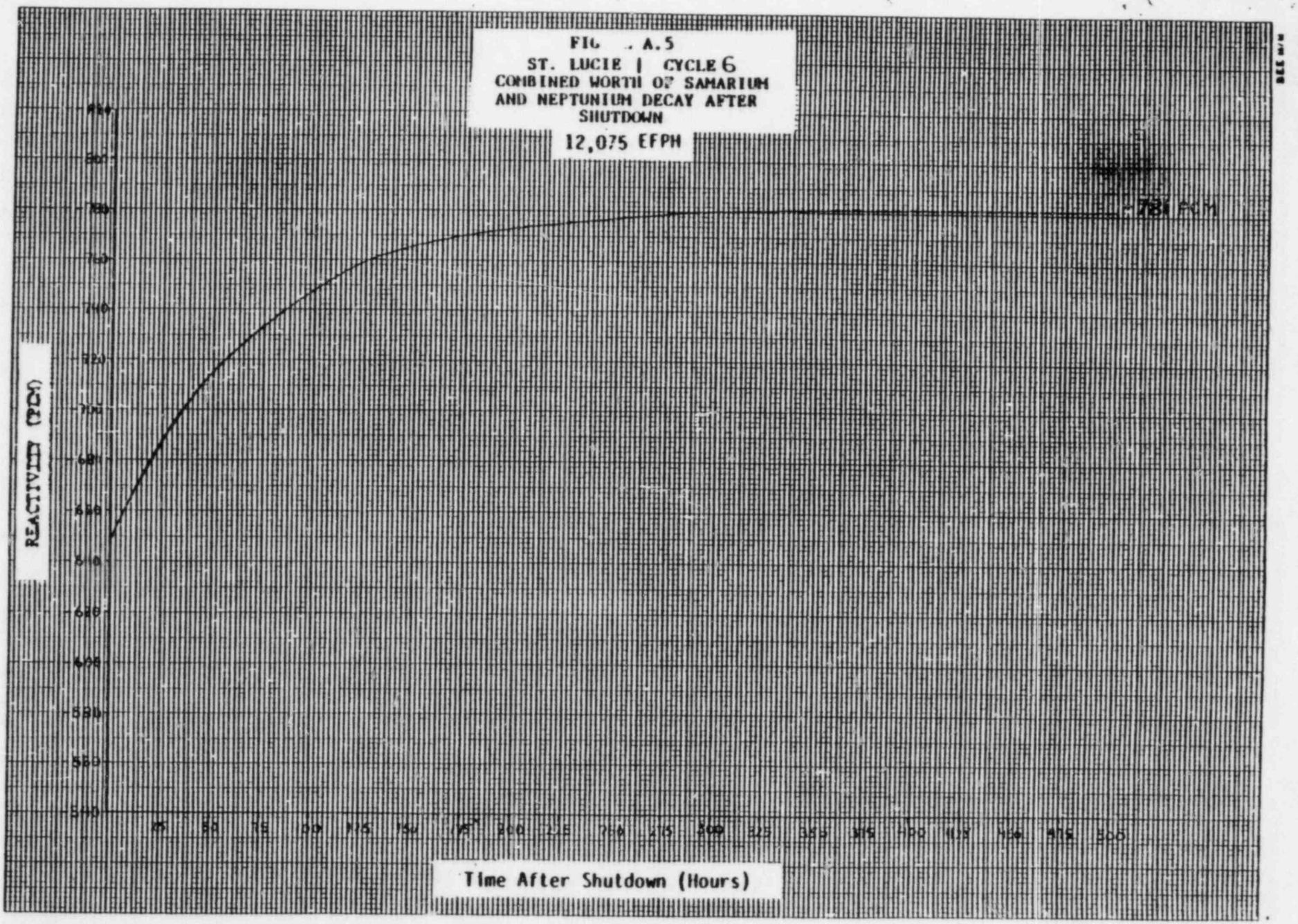


FIG . A.5
ST. LUCIE | CYCLE 6
COMBINED WORTH OF SAMARIUM AND NEPTUNIUM DECAY AFTER SHUTDOWN
12,075 EFPH
REACTIVITY (PCM)
Time After Shutdown (Hours)

6-5-85

FIG. A

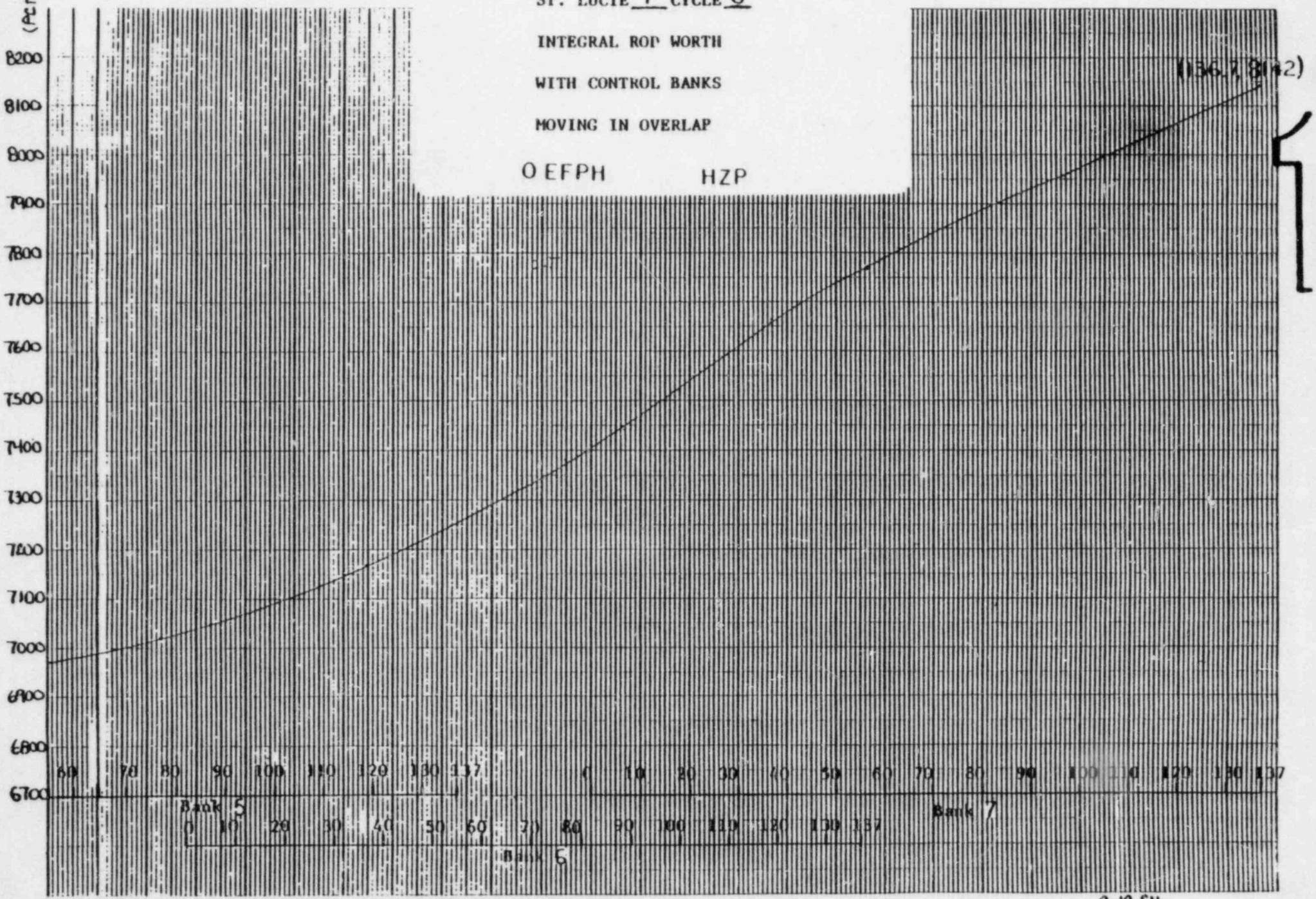
ST. LUCIE 1 CYCLE 6

INTEGRAL ROD WORTH

WITH CONTROL BANKS

MOVING IN OVERLAP

0 EFPH HZP



3-12-64

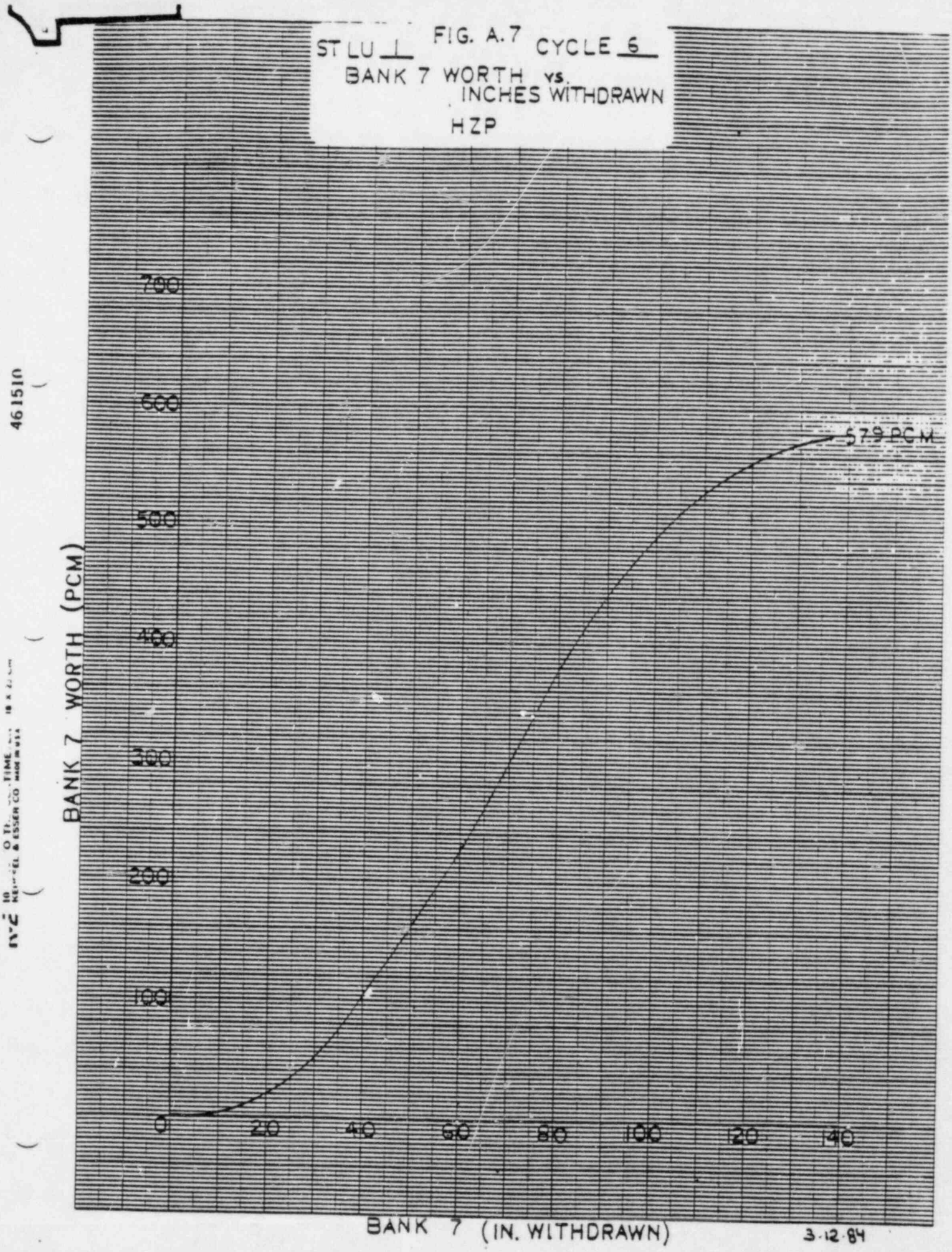
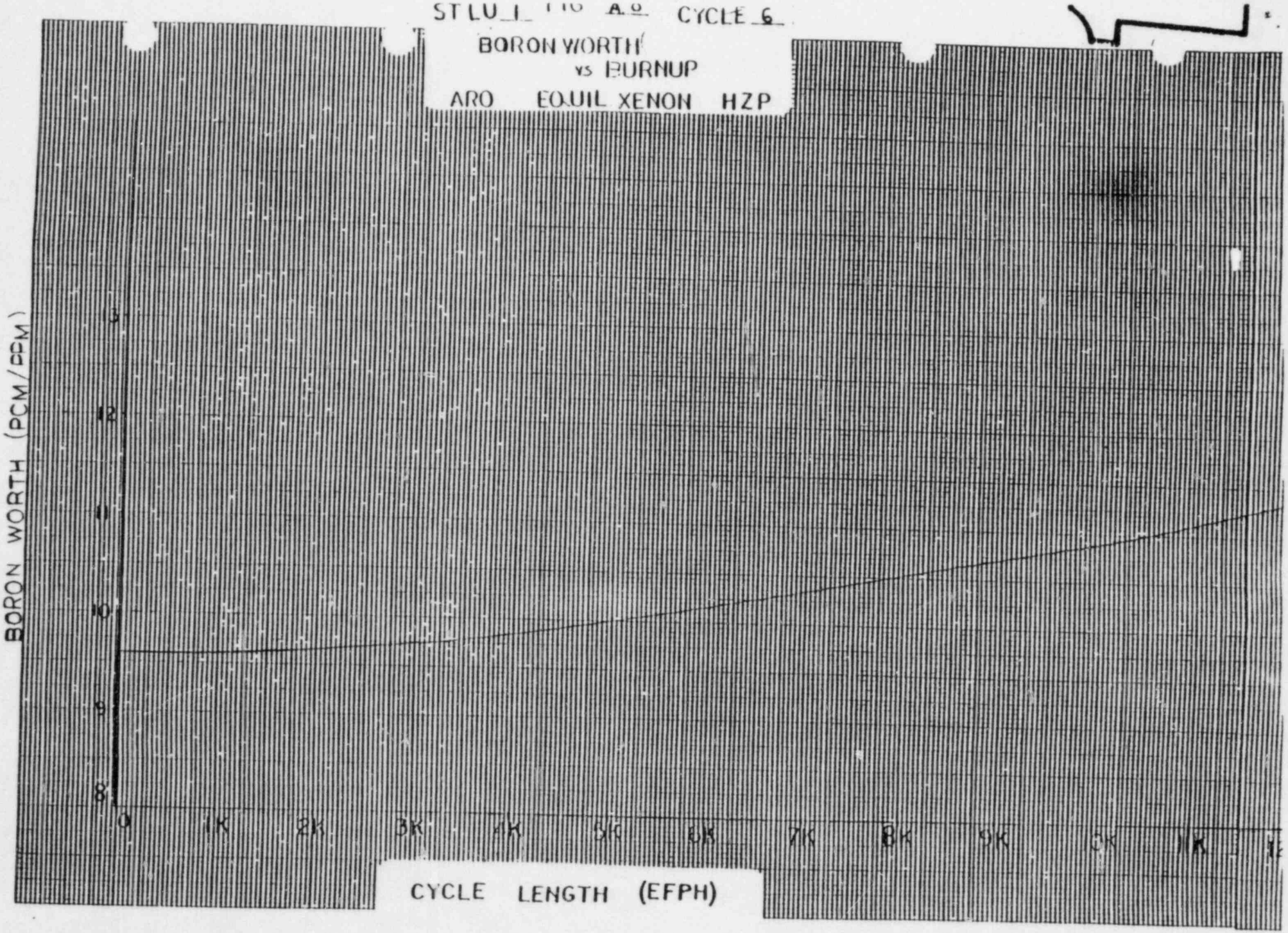


FIG. A.7 CYCLE 6
ST LU 1
BANK 7 WORTH vs. INCHES WITHDRAWN
HZP
BANK 7 WORTH (PCM)
700
600
500
400
300
200
100
0
20
40
60
80
100
120
140
579 PCM
BANK 7 (IN. WITHDRAWN)
3-12-84

ST LU_1 [illegible] A.0 CYCLE 6

BORON WORTH vs BURNUP

ARO EQUIL XENON HZP



3.12.84

EQUATION FORMULA AND PARAMETER SHEET

Where $\dot{m}_1 = \dot{m}_2$

$(\text{density})_1(\text{velocity})_1(\text{area})_1 = (\text{density})_2(\text{velocity})_2(\text{area})_2$

$KE = \frac{mv^2}{2}$ $\quad PE = mgh$ $\quad PE_1+KE_1+P_1V_1 = PE_2+KE_2+P_2V_2$ $\quad$ where V = specific volume, P = Pressure

---

$Q = \dot{m}c_p(T_{out}-T_{in})$ $\quad Q = UA\,(T_{ave}-T_{stm})$ $\quad Q = \dot{m}(h_1-h_2)$

$P = P_0 10^{(SUR)(t)}$ $\quad P = P_0 e^{t/T}$ $\quad SUR = \frac{26.06}{T}$ $\quad T = \frac{(\beta - \rho)}{\rho}$ $\quad \ell_m = \frac{(\beta - \rho)}{\rho \lambda_{eff}}$

$\text{delta } K = (K_{eff}-1)$ $\quad CR_1(1-K_{eff1}) = CR_2(1-K_{eff2})$ $\quad CR = S/(1-K_{eff})$

$M = \frac{(1-K_{eff1})}{(1-K_{eff2})}$ $\quad SDM = \frac{(1-K_{eff}) \times 100\%}{K_{eff}}$

$\text{decay constant} = \frac{\ln(2)}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ $\quad A_1 = A_0 e^{-(\text{decay constant})x(t)}$

Water Parameters

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3

Heat of Vaporization = 970 Btu/lbm
Heat of Fusion = 144 Btu/lbm
1 Atm = 14.7 psia = 29.9 in Hg

Miscellaneous Conversions

1 Curie = 3.7×10^{10} dps
1 kg = 2.21 lbs

1 hp = 2.54×10^3 Btu/hr

1 MW = 3.41×10^6 Btu/hr
1 Btu = 778 ft-lbf

Degrees F = (1.8 x Degrees C) + 32
1 inch = 2.54 centimeters
$g = 32.174$ ft-lbm/lbf-sec^2

---

1 ft H_2O = 0.4335 $lbf/in.^2$ $\quad \lambda_{eff} = 0.08\ sec^{-1}$
