U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-295/OLS-86-06

Docket Nos. 50-295 and 304 Licenses No. DRP-39; 48

Licensee: Commonwealth Edison
Post Office Box 767
Chicago, IL 60690

Facility Name: Zion Nuclear Power Plant

Examination Administered At: Zion, Illinois

Examination Conducted: October 14, 15 and 16, 1986

Examiners: TM Burdick for L. J. Defferding — 11/19/86 Date

TM Burdick for R. L. Gruel — 11/19/86 Date

TM Burdick for W. C. Hemming — 11/19/86 Date

Approved By: TM Burdick Thomas M. Burdick, Chief
Operating Licensing Section — 11/19/86 Date

Examination Summary

Requalification Examination administered on October 14, 15 and 16, 1986 (Report No 50-295/OLS-86-06) to eight Senior Reactor Operators and four Reactor Operators.
Results: Seven Senior Reactor Operators and four Reactor Operators passed.

REPORT DETAILS

1. Examiners

*L. J. Defferding
R. L. Griel
W. C. Hemming

*Chief Examiner

2. Examination Review Meeting

Refer to Attachment 1.

3. Exit Meeting

On October 16, 1986, at the conclusion of the requalification examinations the examiners met with the members of the plant staff to discuss generic findings made during the course of the examinations. The following personnel attended the exit meeting.

G. Pliml, Station Manager
T. Rieck, Services Superintendent
E. Fuerst, Production Superintendent
R. Landrum, Operations Training Group Leader
W. Kurth, Assistant Superintendent for Operations
T. Blake, Principal Instructor
L. Kanter, Zion Resident Inspector, NRC
L. Defferding, PNL
R. Gruel, PNL
W. Hemming, INEL
T. Burdick, RIII, NRC
R. Higgins, RIII, NRC
P. Sunderland, RIII, NRC
S. Hare, RIII, NRC

a. It was noted during the examinations that licensed personnel assigned outside the control room displayed more weaknesses in their knowledge of systems outside the control room than they did for control room systems.

b. Shift personnel were exceptionally knowledgeable and proficient in their use of procedures. Non shift personnel were generally weaker in simulator operations and procedural knowledge than shift personnel. These weaknesses were especially evident in personnel who normally work away from the facility.

c. The personnel who operated the simulator during the examination were very competent and cooperative.

d. Health physics and security personnel were very cooperative and efficient, permitting the examiners to enter the site and gain access to the auxiliary building with minimum delays.

e. Control room operators were very cooperative.

f. In a followup telephone conversation on November 19, 1986, between T. Burdick, Chief, Operator Licensing Section and M. Carnahan, Zion Training Supervisor, it was determined that the one individual who failed the operating/simulator examination is not and will not be used in a licensed capacity. He will be enrolled in an accelerated retraining program to correct identified weaknesses according to the current retraining program requirements. Followup monitoring by Region III may be performed to verify that corrective action has been met.

ATTACHMENT 1

The specific facility comments concerning the requalification examinations, followed by the NRC resolution, are listed in the following paragraphs.

Question 1.02a

Comment: The acceptable range of values from Figures 1.1, 1.2 seem a little narrow, especially considering how an "early error" can compound through the solution.

Resolution: Comment noted. Initial range was sufficient. No change.

Answer 1.03c and d

Comment for part c: The stated reference does not appear to support the key answer. Curves and data provided to operators do not change with core life, nor even between cycles - the current Curve Book Figure 1.10 "Xenon Worth After Step Change in Power from 0% to Indicated Power" has been in use since April 21, 1976. Therefore, any change in equilibrium xenon reactivity with core life is essentially negligible, and answer should be FALSE. (Attached Reference 1.03)

Comment for Part d: From the key answer, it appears that "Equilibrium xenon concentration after a trip" is interpreted to mean "clean core," or no xenon, an uncommon interpretation of definition. Equilibrium xenon is commonly defined as the condition where xenon production equals removal, a condition which ones exist, very briefly, after shutdown at the peak xenon value. As stressed in our training, the after shutdown peak xenon value is a function of the previous power level. This interpretation, in view of requal training, is more plausible than that of the key, and yields the opposite answer. Therefore, recommend that the answer be changed to TRUE.

Resolution: Comment accepted. Answer key changed to read:

c. False (concentration changes with life, but not reactivity)
d. False; True with appropriate explanation

Answer 1.09

Comment: While the stated reference does provide the three indications listed by the key, the paragraphs which follow that list provide explanation of these indications as well as further indications. We recommend that the acceptable answer be expanded to include any three of the five "conditions that support or indicate natural circulation flow" as stated in ES-0.4 (Emergency Procedures) Page 21, Table 1. Each is supported within Pages 14-27 and 14-28 of the reference as indicated. (Attached Reference 1.09)

Resolution: Comment accepted. Answer key expanded to include:

4. >30 degree F subcooling
5. core inlet temperature at saturation temperature for SG pressure

[+0.5] each; +1.5 maximum

Question 1.10

Comment: Although not indicated by the stated reference, Answer C. can also be supported, in that the piping associated with the second pump slightly modifies the system configuration so as to change the system head loss curve. Reference: Centrifugal Pumps, Igor Karrassik and Roy Carter, C 1960, McGraw-Hill, Pages 235-236. (Attached Reference 1.10)

Resolution: Question Deleted.

Answer 2.02

Answer key changed to read:

c. phase "A" isolation or SI [+0.5]

Question 2.03

Comment: The question appears to solicit a one of four response while the key allows a two of four response. As written the question may trigger a one of four response particular to Unit No. 1 (GOP-1 caution under Item 19 B Page 23). Recommend correct answer include C pump if explained per GOP-1. (Attached Reference 2.03)

Resolution: Comment noted. No change in key.

Question 2.06

Comment: The design values for RHR pump recirc valves are 1,000 and 500 gpm (Zion System Description Chapter 10, Pages 10-4). Due to flow switch problems the current setpoints are 900 gpm and 600 gpm.

Resolution: Comment noted - Not part of answer required. No change in key.

Answer 3.07b

Comment: Answer Item No. 8: Recommend remove the words "motor-driven" since the diesel - driven CS pump also receives a signal from the Safeguards Sequence Timer. (Attached Reference 3.07)

Resolution: Comment accepted. Answer key changed to read:

8. CS pumps (if Hi-Hi containment pressure)

Answer 3.09a and c

Comment:

a. Assume that the portion of the answer enclosed in parenthesis is unnecessary for full credit since the question did not specifically require setpoints and coincidence.

b. (Assume the facility's comment is referring to Answer C.) The answer contains more detail than the question elicits. Recommend that "By use of switch on MCB" be acceptable for full credit.

Resolution: Answer a - The information inside the parentheses is not required for full credit. Answer c - Answer key change to read:

c. by turning the individual loop test switch controls for each valve to the "reset" position (also on the safeguards section of the MCB) or switch on MCB [+0.5]

Reference 4.01

Changed to read:

1. Zion: GOP-1 Precautions, W, S, F-F, and H-H.

Answer 4.02

Point value of answer changed. Key changed to read:

a. Eliminate deviation [+0.5] or reduce rector power to no greater than 90% power [+0.5] (and meet the applicable limits).

b. Immediately reduce load [+0.8] to 80% or less [+2.0].

Question 4.07

Comment: The question may be interpreted as "list the immediate action steps which must be accomplished before the emergency boration step" i.e.: Verify reactor trip; etc. Recommend allowance be made for this in considering acceptable answers.

Resolution: Comment noted. No change to key.

Question 5.01

Comments: a and b: Recommend that the point distribution be adjusted to allow more points for a demonstrated understanding of the concept (subcritical count rate dependency on Keff) and fewer points for mathematical manipulations. Answer b - Recommend that some allowance be made for the fact that the assumption "rho = K-1" is essential to problem solution without becoming involved in complex mathematical operations, and per the stated reference, this assumption is valid only when operating with K approximately 1.0.

Resolution: Assumption valid since K was close enough to one. No change to key.

Question 5.02a

Same comment and resolution as Question 1.02a.

Question 5.03b, d and e

b. Same comment and resolution as Question 1.03c

d. Since the post-shutdown reactivity insertion due to Samarium is essentially offset by the coincident change in Plutonium, Samarium has an insignificant effect on plant operation, is not included in any operator - performed calculations, and is not included in the retraining program. Therefore, it is recommended that this item be deleted.

e. Same comment and resolution as Question 1.03d

Resolution: d. Comment noted. No change to answer key.

Answer 5.06

Point value in the answer changed. Answer key changed to read:

. . . Therefore the heat flux = 15 x 10**6 (1192-402) BTU/hr
= 1.2 x 10**10 BTU/hr [+0.3]

. . . = 3470 Mw [+0.2] (3350 - 3500 Mw acceptable)

Question 5.07

Comment: Recommend that:

1. The acceptable delta T range for the key be extended to 100% of full power delta T, since the acceptable power extends to 6%.

2. Solutions including reasonable initial assumptions and utilizing the relationships "heat flux is proportional to the cube of the mass flow rate" and "differential temperature is proportional to the square of the mass flow rate" (for natural circulation) be also considered as acceptable. (Attached Reference 5.07)

Resolution: Comment 1 accepted. Answer key changed to read: . . . (25-100% acceptable). Comment 2 not accepted. These relationships valid only for changes within NC conditions; not for changes from forced flow to NC conditions.

Question 5.08

Question deleted from the examination.

Question 6.02b

Comment: Recommend that a Tave - Tref temperature error (Tref fails low when PT-505 fails low) be considered as an acceptable alternate reason for inward rod movement. (Attached Reference 6.02)

Resolution: Comment accepted. Answer key changed to read:

. . . rate change due to an instantaneous power mismatch or temperature error [+0.5] . . .

Answer 6.04a

Comment: Recommend two additional possible correct answers be considered acceptable:

1. Technical Specifications 3.3.2 B.1.b. (Page 82)
   - One PORV open.

2. Technical Specifications 3.3.2.G.3. (Page 83)
   - allowable delta T, S/G to RCS, for starting first RCP when below 250 degree F. (Attached Reference 6.04)

Resolution: Comment accepted. Answer key expanded to include:

4. 1 PORV open

5. RCP starting criteria (delta T RCS and SG when below 250 degree F)

[+0.5] each; +1.5 maximum

Answer 6.05a and b

Comment:

a. Since the 2.5 mr/hr. criteria applies while moving fuel, a qualification not imposed by the question, recommend acceptable alternate answers of "avoidance of Spent Fuel Pit overflow (high level)" and "loss of suction for Spent Fuel Pit Pumps (low level)." (Attached Reference 7.05a)

b. As per the attached reference, recommend that the following be added as acceptable answers:

1. Holdup Tanks
2. RWST Unit 1
3. RWST Unit 2
4. Refueling Cavity Unit 1
5. Refueling Cavity Unit 2

(Attached Reference 6.05b)

Resolution: Comment partially accepted.

Answer a - Answer key changed to include NOTE: Pump suctions or overflow only worth [+0.5] pts., must mention radiation for full credit.

Answer b - Answer key expanded to include:

6. HUT
7. Primary Water
8. Other Unit RWST

Question 6.07

Comment: Note that although the low FWP NPSH alarm occurs at approximately 275 psig, the protective features are not initiated until approximately 160 psig. (Attached Reference 6.07)

Resolution: Comment noted. No change to key.

Question 6.09

Question changed to read: LIST the four (4) of five (5) reactor trip signals . . .

Answer 7.01

Comment:

a. Recommend hydrazine removal by demineralizers (as contrasted to hydrazine saturation of demineralizers) also be considered as an acceptable answer. (Attached Reference 7.021a)

e. Recommend that avoiding "risk of thermal shocking pump shaft, bearing and seal" be considered as alternate acceptable answer. (Attached Reference 7.02a)

Resolution: Comment accepted. Answer key changed to read:

a. avoids hydrazine saturation in demineralizers or loss of hydrazine from RCS.

c. maintains uniform RCS boron concentration [+0.5]; (partial credit given for maintenance of forced flow [+0.2])

e. answer key expanded to also grant full credit for the response "risk of thermal shocking pump shaft, bearing and seal."

Answer 7.02

Point values changed in answer key.

a. Eliminate deviation [+0.5] or reduce reactor power to no greater than 90% power [+0.5] (and meet the applicable limits).

b. Immediately reduce load [+0.8] to 80% or less [+0.2].

Answer 7.06b

Comment: The specific key answer requires operator memorization of a "Response Not Obtained" action for an EOP step which is not an immediate action step, and memorization of valve function by valve number. Since these are not operator knowledge requirements, recommend full credit be give for a more general answer stating that a rupture exists in A and/or D steam generator(s). (Attached Reference 7.06b)

Resolution: Comment noted. Answer key modified to put less credit on valve lineups.

b. If SG A or D is ruptured [+0.4], its supply line to the turbine-driven AFW pump cannot be closed [+0.2], . . .

Answer 8.01

Comment:

a. The question does not appear to require that restrictions applying to fire brigade members be addressed, therefore recommend that the second half of the key answer regarding "shall not include the minimum shift crew necessary for safe shutdown ---" not be required for full credit.

Resolution: Comment accepted. The answer key was changed to read:

a. Five (5) members at all times [+1.0] (and shall not include the minimum shift crew necessary for safe shutdown of the plant or personnel required for other essential functions during a fire emergency).

Answer 8.02

Comment: Recommend that the following items from ZAP 5-51-16 "Precautions" section be added to the list of acceptable answer, and that full credit be given for any three of the resulting six acceptable answers.

1. Entry has been authorized by approved personnel.
2. Radiation survey completed.
3. Safety person stationed.

(Attached Reference 8.02)

Resolution: Comment accepted. The following note was added to the answer key: NOTE - Surveys and permission are acceptable alternative answers.

ENCLOSURE 3

REQUALIFICATION PROGRAM EVALUATION REPORT

Facility: ZION

Examiner: Higgins, Defferding, Gruel, Hemming

Date(s) of Evaluation: 10/14-16/1986

Areas Evaluated: X Written X Oral X Simulator

Examination Results:

	RO Pass/Fail	SRO Pass/Fail	Total Pass/Fail	Evaluation (S, M, or U)
Written Examination	4/0	8/0	12/0	S
Operating Examination				
Oral	4/0	7/1	11/1	S
Simulator	4/0	7/1	11/1	S
Evaluation of facility written examination grading				NA

Overall Program Evaluation

Satisfactory X Marginal ____ Unsatisfactory ____ (List major deficiency areas with brief descriptive comments)

Submitted: T M Burdick for
R. L. Higgins
Examiner

Forwarded: T M Burdick
T. M. Burdick
Section Chief

Approved:
Charles W. Hehl
Branch Chief

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

FACILITY: ZION 1&2

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 86/10/14

EXAMINER: DEFFERDING, L./GRUEL, R.

CANDIDATE: ANSWER KEY Proctor

INSTRUCTIONS TO CANDIDATE:

Read the attached instruction page carefully. This examination replaces the current cycle facility administered requalification examination. Retraining requirements for failure of this examination are the same as for failure of a requalification examination prepared and administered by your training staff. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up four (4) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
~~15.00~~ 14	~~25.00~~ 23.3			5.	THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
15.00	~~25.00~~ 42			6.	PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
15.00	~~25.00~~ 42			7.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
15.00	~~25.00~~ 42			8.	ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
~~60.00~~ 59					Totals

Final Grade

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

Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

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

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

6. Use only the paper provided for answers.

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

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

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

10. Skip at least three lines between each answer.

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

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

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

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

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

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

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

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

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

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

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

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

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

QUESTION 5.01 (3.00)

A questionable ECP calculation reveals that criticality should be achieved when 3000 pcm has been added to the core. A boron dilution of 150 ppm B (1500 pcm) is planned, followed by control rod withdrawal to criticality. The initial count rate is 50 cps.

a. WHAT is the expected count rate after the 150 ppm B boron dilution? (1.0)

b. Following the first 75 ppm B dilution, the source ranges indicate 80 cps. WHAT amount of reactivity in pcm should the original ECP calculation have derived as sufficient to reach criticality? (2.0)

QUESTION 5.02 (2.50)

Zion Unit 1 is operating at 100% power with 450 ppm boron. Reactor power is to be decreased to 85%. Initial Bank D rod position is 200 steps.

a. Use Figures 5.1 and 5.2 to determine the final rod position if boron concentration is to remain unchanged. (2.0)

b. WOULD a SMALLER or LARGER rod insertion be required if the same power maneuver were performed at EOL? (0.5)

QUESTION 5.03 (2.50)

ANSWER the following TRUE or FALSE.

a. Equilibrium samarium concentration is a function of power. (0.5)

b. Equilibrium xenon reactivity is dependent upon core burn up. (0.5)

c. Xenon concentration initially increases after a reactor trip. (0.5)

d. Equilibrium samarium concentration after a trip is a function of the previous power level. (0.5)

e. Equilibrium xenon concentration after a trip is a function of the previous power level. (0.5)

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

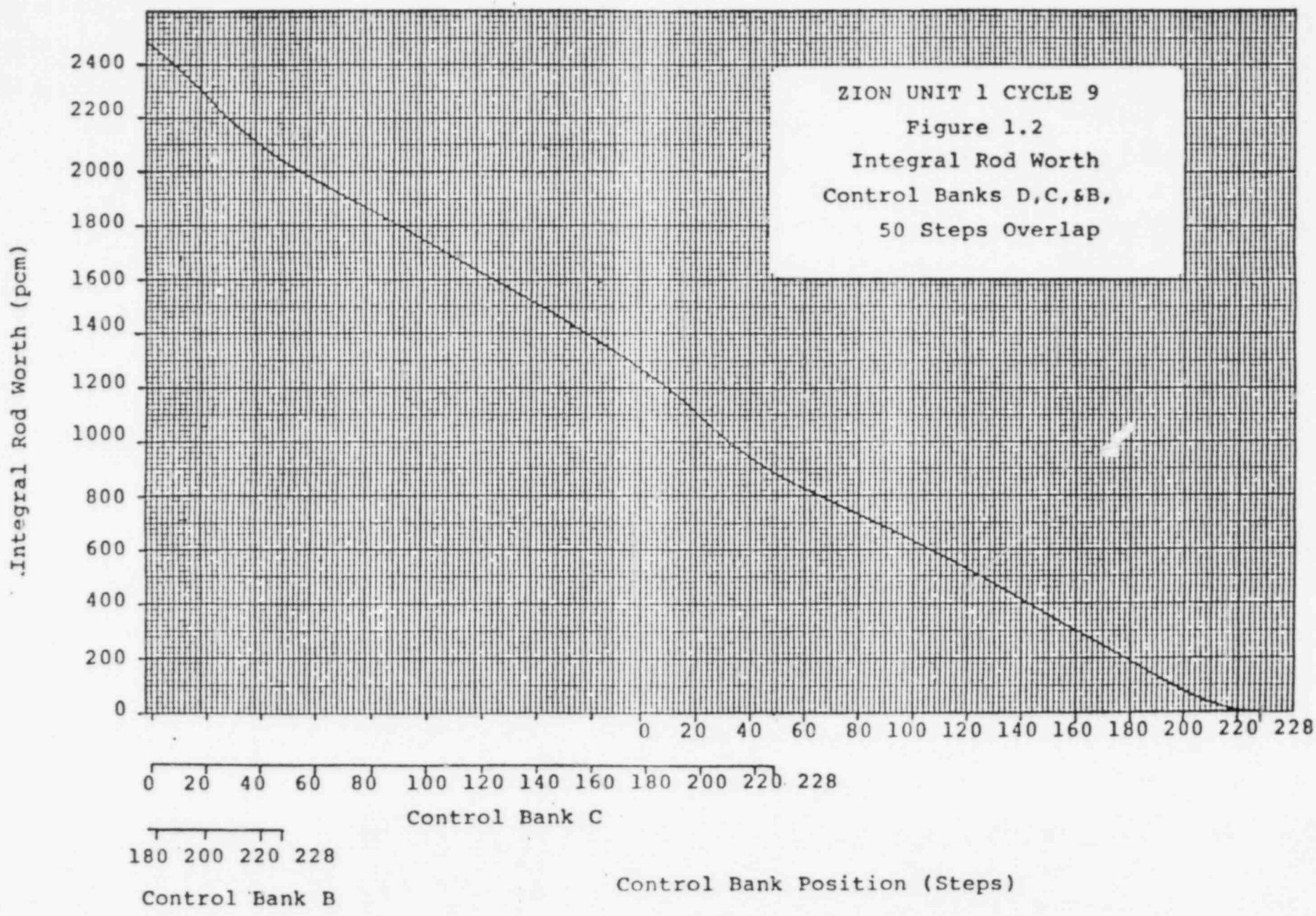
ZION UNIT 1 CYCLE 9
Figure 1.2
Integral Rod Worth
Control Banks D,C,&B,
50 Steps Overlap
Integral Rod Worth (pcm)
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180 200 220 228
0 20 40 60 80 100 120 140 160 180 200 220 228
Control Bank C
180 200 220 228
Control Bank B
Control Bank Position (Steps)

FIGURE 5.1

ZION UNIT 1 CYCLE 9

Figure 1.4

Total Power Defect (Doppler & Moderator)

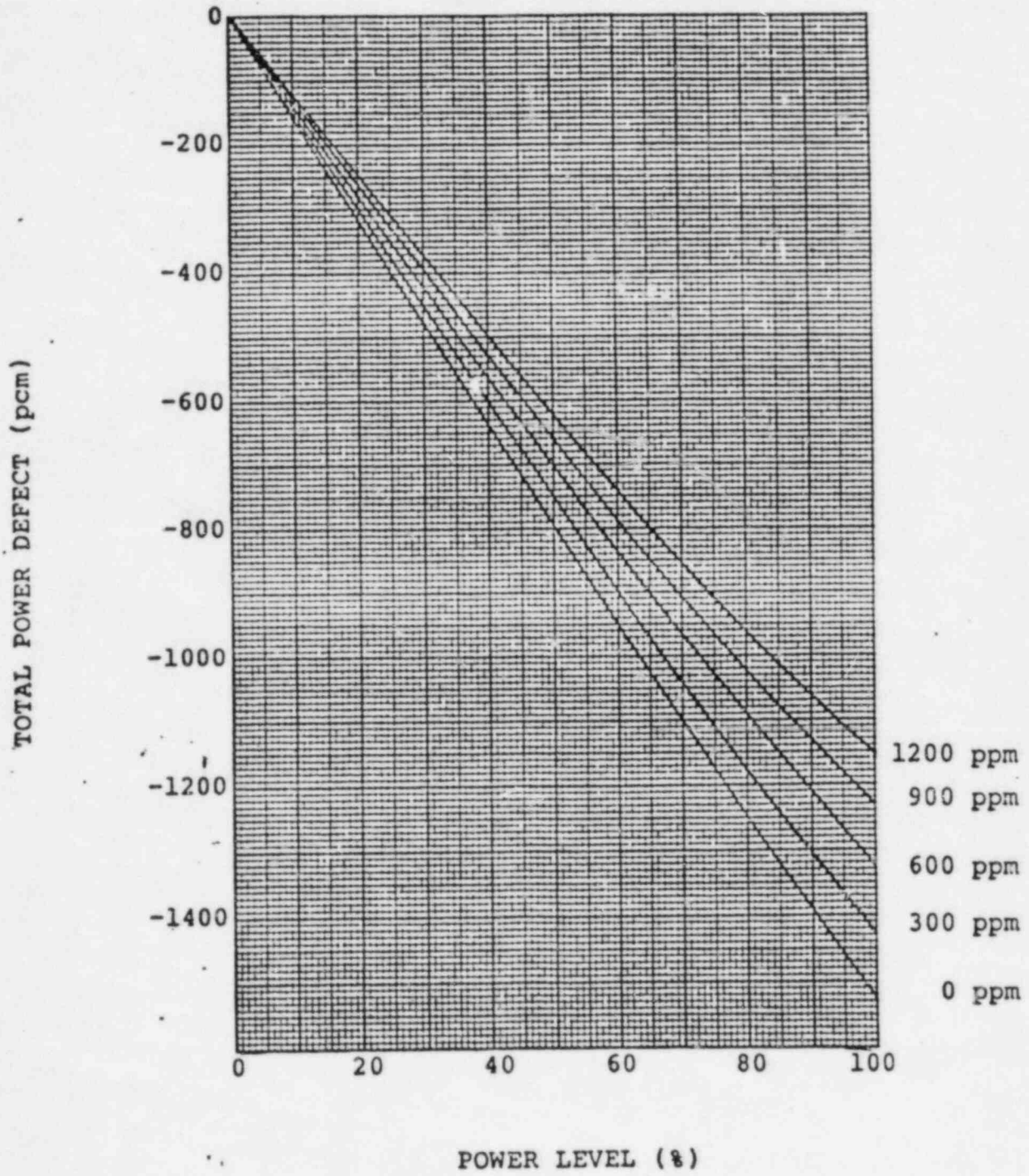

FIGURE 5.2

QUESTION 5.04 (1.00)

WHICH of the following does NOT occur over core life, i.e., from BOL to EOL? (1.0)

(a.) axial power distribution flattens
(b.) effective fuel temperature decreases
(c.) MTC becomes more negative
(d.) reactor response time increases

QUESTION 5.05 (1.00)

A relief valve (to the atmosphere) on a pipe opens at 885 psig. The temperature of the exhausted steam is 320 deg F. The temperature of the fluid (water or steam) within the pipe is approximately: (1.0)

(a.) 540 deg F
(b.) 400 deg F
(c.) 320 deg F
(d.) 212 deg F

QUESTION 5.06 (2.00)

15.0 x 10**6 lbm/hr of 428 deg F feedwater is being delivered to to the steam generators at 1010 psig. CALCULATE the thermal power in Mw that is being produced by the reactor. SHOW your work. (2.0)

QUESTION 5.07 (2.00)

A reactor trip occurs at 100% power due to loss of offsite power. CALCULATE the core flow, in terms of a percent of core flow at power, that exists when natural circulation is established. STATE all assumptions. SHOW your work. (2.0)

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

QUESTION 5.08 (1.00)

Deleted

Two (2) identical centrifugal pumps are connected in parallel in a fluid system. If initially only one (1) pump is operating, and then the second pump is started, WHICH one of the following is correct: (1.0)

(a.) total discharge pressure remains the same
(b.) total system flow doubles
(c.) system head loss curve changes
(d.) minimum required NPSH decreases

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

QUESTION 6.01 (1.00)

The OP delta T setpoint is a calculated value determined by 109% full-power delta T, minus correction proportional to the rate of: (1.0)

(a.) increase of T-ave, minus correction proportional to variation of delta T above full-load value.

(b.) increase of T-hot, minus correction proportional to variation of T-hot above full-load T-hot.

(c.) increase of T-ave, minus correction proportional to variation of T-ave above full-load T-ave.

(d.) increase of T-hot, minus correction proportional to variation of delta T above full-load value.

QUESTION 6.02 (2.00)

Briefly EXPLAIN the response of the Rod Control System for each of the following instrument failures. INCLUDE in your answer direction of motion, why the motion occurs as it does, and any controls or permissives encountered (and their effects). Assume the plant is at 75% power with all systems in automatic and no operator action or protective trips occur. (2.0)

a. Loop B(2) Cold Leg RTD fails LOW.

b. Turbine Impulse Pressure (PT-505) fails LOW.

QUESTION 6.03 (2.00)

DESCRIBE the actions and loading of the vital ESS buses of the Zion station under the following conditions:

a. A station loss of off-site power (blackout) occurs 30 seconds after an ESF actuation has occurred. Assume off-site power was available initially. (1.0)

b. An ESF actuation occurs 5 minutes after a station blackout. (1.0)

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

QUESTION 6.04 (1.50)

When the temperature of the RCS is less than 250 deg F and the head is installed, LIST three (3) means that are available to protect the RCS from overpressurization due to a pressure transient per Technical Specifications? (1.5)

QUESTION 6.05 (2.00)

ANSWER the following concerning the Spent Fuel Pool (SFP):

a. WHY is SFP level maintained within 3 in. of normal? (1.0)

b. LIST four (4) normal and alternate sources of makeup water for the SFP. (1.0)

QUESTION 6.06 (1.50)

The following concern the CVCS:

a. If left in the automatic control, WHAT position should PCV-131 be found in two (2) minutes after a safety injection initiation? (CLOSED, OPEN, or AS-IS) (0.5)

b. WHY is letdown flow limited to 120 gpm? (0.5)

c. With only the PD pump operating at power, WHICH valve(s) is/are utilized to vary RCP seal injection flow? (Either valve name(s) or number(s) acceptable.) (0.5)

QUESTION 6.07 (2.00)

If the available Feedwater Pump NPSH decreases to 275 psig, an alarm sounds. WHAT other four (4) actions automatically occur when a low FWP suction pressure condition exists? (2.0)

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

QUESTION 6.08 (1.00)

A number of reactor trip functions are always operable (never blocked either manually or automatically). IDENTIFY three (3) of these functions, EXCLUDING those directly associated with the Ex-Core NIS. (1.0)

QUESTION 6.09 (2.00)

LIST the four (4) of five(5) reactor trip signals that are blocked/unblocked by the "At Power Permissive" P-7. (Setpoints and coincidences not required.) (2.0)

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

QUESTION 7.01 (3.00)

GOP-1 lists several precautions. STATE the concern which is addressed by each of the following.

a. Bypassing the CVCS demineralizers during oxygen scavenging. (0.5)

b. Periodically opening the pressurizer spray valves during heatup. (0.5)

c. Putting an RCP in operation before taking the RHR system OOS. (0.5)

d. Adjusting VC-HCV-182 after a significant charging flow change. (0.5)

e. Leaving the RCP seal bypass valve closed during a loss of injection water. (0.5)

f. Opening the reactor trip breaker or deenergizing the M.G. sets when T-ave is between 350 and 547 deg F with less than four (4) RCPs running. (0.5)

QUESTION 7.02 (2.00)

According to GOP-3, WHAT action must be taken for each of the following during operation at 100% power?

a. Delta-I deviates from the target band (1.0)

b. An Intercept Stop Valve inadvertently closes (1.0)

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

QUESTION 7.03 (2.00)

Regarding Turbine/Generator operation:

a. STATE the setpoint where a turbine trip should automatically or manually occur. If setpoints are unit specific, state BOTH setpoints.

1. low condenser vacuum (0.5)
2. turbine vibration (0.5)
3. stator water inlet conductivity (0.5)

b. WHY is high stator water inlet conductivity of concern? (0.5)

QUESTION 7.04 (1.50)

In the event of a fuel handling emergency, WHAT valve/system lineups should immediately be verified? (1.5)

QUESTION 7.05 (2.00)

After SI has been terminated, under WHAT conditions should charging and SI pumps be restarted? Include parameter AND setpoints. (2.0)

QUESTION 7.06 (2.00)

Regarding the steam generators during emergency operations,

a. DEFINE each of the following terms

1. faulted (0.5)
2. ruptured (0.5)

b. Under WHAT condition should the turbine driven AFW pump be isolated (MOV-MS0006 closed) to prevent it being a radiation release path? (1.0)

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

QUESTION 7.07 (2.50)

ECA-0.0 is entered due to a loss of all AC power.

a. WHAT priority (color) of a Functional Restoration Procedure allows exit from ECA-0.0? (0.5)

b. 1. DEFINE the conditions under which ADVERSE CONTAINMENT exists. (1.0)

2. If the ADVERSE CONTAINMENT parameters decrease below setpoint, can normal values subsequently be used? (1.0)

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

QUESTION 8.01 (1.50)

a. WHAT are the manning requirements for the fire brigade on the back shifts? (1.0)

b. Under WHAT conditions can the minimum shift crew be less than the required per Technical Specifications? (0.5)

QUESTION 8.02 (1.50)

WHAT are the conditions that have to be satisfied before an entry into the incore shaft area can be considered? (1.5)

QUESTION 8.03 (1.00)

CHOOSE the correct response. A jumperlog authorizing the installation of an electrical jumper must be signed by: (1.0)

(a.) center desk NSO and operating engineer
(b.) shift foreman and center desk NSO
(c.) shift engineer and shift foreman
(d.) unit NSO and shift foreman

QUESTION 8.04 (2.00)

INDICATE whether the following is a primary function of the Shift Engineer OR Shift Foreman (licensed), according to ZAP 1-151-1, Station Organization.

a. authorize surveillance (0.5)

b. act as fire chief (0.5)

c. placing equipment in or out of service (0.5)

d. ensure unqualified operating personnel perform evolutions in the presence of qualified personnel (0.5)

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

QUESTION 8.05 (2.50)

Primary to secondary leakage through the steam generator tubes has two (2) Technical Specification leakage rate criteria.

a. WHAT are the allowable leakage rates? (1.0)

b. WHAT is the bases for each of the leakage rates? (1.5)

QUESTION 8.06 (2.50)

Pertaining to "Recommended Protective Actions" (with analysis not complete) WHICH are in EPIP 100-1, EPIP 110-1 and the GSEP, ANSWER the following:

a. WHAT parameter is utilized for determining recommended protective actions during an Alert or Site Emergency with dose projections not complete? (0.5)

b. LIST four (4) of the five (5) parameters used to determine protective actions for a General Emergency with dose projections not complete. (2.0)

QUESTION 8.07 (2.00)

The Technical Specifications permit the containment hatch or both air lock doors to be open during refueling operations provided certain conditions are maintained.

a. LIST the two (2) conditions. (1.0)

b. How are the above conditions verified? (0.5)

c. HOW often must these conditions be verified? (0.5)

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

QUESTION 8.08 (2.00)

ANSWER TRUE or FALSE to the following statements regarding ZAP 5-51-4, "Procedure Control and Approval."

a. This procedure provides direction for establishing new procedures, for changing existing procedures, and for controlling procedure distribution. (0.5)

b. Temporary and Special Procedures expire in 30 days unless specifically stated otherwise. (0.5)

c. Temporary procedure changes must be "on-site reviewed" within 14 days of the change. (0.5)

d. Two on-shift operating SROs may approve a temporary change to a ZAP. (0.5)

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

ANSWER 5.01 (3.00)

a. (Since the amount of reactivity inserted is one-half of the total amount needed to reach criticality,) the count rate should double, or about 100 cps. [+1.0]

OR

For rho = K-1 (valid approximation)

$$CR1/CR0 = (1-K0)/(1-K1)$$
$$= (1-(rho0 + 1))/(1-(rho1 + 1))$$
$$= rho0/rho1$$
$$= 2$$
$$CR1 = 2*CR0 = 100 \text{ cps (actual is 98.54 cps)} \quad [+1.0]$$

b. For rho = K-1

$$CR1/CR0 = rho0/rho1$$
OR
$$rho0 = rho1*CR1/CR0 \quad [+0.5]$$

Since the change in reactivity was 750 pcm (one-half of the total dilution): [+0.5]

$$rho0 = (rho0 + 750 \text{ pcm})*CR1/CR0$$
$$= (rho0 + 0.0075)*80/50$$
$$= 1.6\ rho0 + 0.012$$

$$-0.6\ rho0 = 0.012$$
$$rho0 = -0.02$$
$$= -2000 \text{ pcm}$$

Therefore, the original ECP should have determined that criticality would be achieved if 2000 pcm was added to the core. [+1.0]

REFERENCE

1. Generic: Westinghouse Fundamentals of Nuclear Reactor Physics, pp. 5.22 through 5.29 and 8.39 through 8.41.

ANSWER 5.02 (2.50)

a. From Figure 5.1:

defect at 100% power: -1375 pcm (+/- 5 pcm acceptable)
defect at 85% power: -1195 pcm (+/- 5 pcm acceptable)

Therefore, a reactivity change of 180 pcm (+/- 10 pcm) is required. [+1.0]

From Figure 5.2:

rod worth at 200 steps: 80 pcm

required rod worth: 260 pcm (180 + 80) (250 - 270 pcm acceptable)

This corresponds to a rod position of 168 steps (166 - 170 acceptable) [+1.0]

b. Larger [+0.5].

Note: Figures 5.1 and 5.2 are Figures 1.2 and 1.4, respectively.

REFERENCE

1. Zion: Station Curve Book, Figures 1.2 and 1.4.

ANSWER 5.03 (2.50)

a. False
b. ~~True~~ False (Concentration changes with life, but not reactivity)
c. True
d. True
e. False, TRUE with explanation

[+0.5] each

REFERENCE

1. Generic: Westinghouse Reactor Core Control, pp. 4-31, 4-18, 4-21, 4-33, and 4-22.

ANSWER 5.04 (1.00)

(d.) [+1.0]

REFERENCE

1. Generic: Westinghouse Reactor Core Control, pp. 8-21, 2-45, 3-19, and 2-23.

ANSWER 5.05 (1.00)

(a.) [+1.0]

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 10-67 through 10-71.

ANSWER 5.06 (2.00)

Q-dot = m-dot delta-h [+0.5]

m-dot = 15 x 10**6 lbm/hr
h-steam = h-g at 1025 psia = 1192 BTU/lbm [+0.5]

h-feed = h-f at 428 deg F (P-sat for 1025 psia - 120 deg F) = 405 BTU/lbm
OR
= h-f at 1025 psia - (c-p*delta T)
= 548 - (1.2*(548-428)) = 402 BTU/lbm
(400 - 430 BTU/lbm acceptable) [+0.5]

Therefore Q-dot = 15 x 10**6 (1192-402) BTU/hr
= 1.2 x 10**10 BTU/hr [+0.5]

Converting to Mw
Q-dot = 1.2 x 10**10 BTU/hr x (1 Mw/3.41 x 10**6 BTU/hr)
= 3470 Mw [+0.5] (3350 - 3500 Mw acceptable)

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, p. 5.4.

ANSWER 5.07 (2.00)

Assumptions:

Q-dot (nc) = 3% Q-dot (100%) [+0.5] (2-6% acceptable)
delta T (nc) = 50% delta T (100%) [+0.5] (25-~~80~~100% acceptable)

Calculation:

Q-dot (nc)/Q-dot (100%) = m-dot C delta-T (nc)/m-dot C delta-T (100%) [+0.5]

Therefore

m-dot (nc) = [Q-dot (nc/100%)] x [delta-T (100%/nc)] m-dot (100%)
= 0.03 x (1/0.5) m-dot (100%)
= 6% m-dot (100%) [+0.5] (5% to 10% acceptable depending upon assumptions)

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 14-15 through 14-29.

ANSWER 5.08 (1.00)

(d.) [+1.0]

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 10-46 and 10-56.

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ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 6.01 (1.00)

(c.) [+1.0]

REFERENCE

1. Zion: System Description 9-23.

ANSWER 6.02 (2.00)

a. No motion [+0.25]; failure results in loop B T-ave decreasing. Rod control uses Auctioneered High T-ave [+0.25].

b. Rods in [+0.5]; failed impulse pressure will generate a maximum rate change due to an instantaneous power mismatch [+0.5]. C-5 will activate which will prevent any outward auto rod motion [+0.5].

or temp-error.

REFERENCE

1. Zion: System Description 8a-11 through 13.

ANSWER 6.03 (2.00)

a. buses are stripped and ESF loads are sequenced on the bus [+1.0]

b. ESF loads not running are sequenced on bus; loads running on bus previous to this are on due to blackout sequence [+1.0]

REFERENCE

1. Zion: System Description 1-52 and 53.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 6.04 (1.50)

1. only one charge pump allowed operable (no SI pumps or accumulators)
2. 2 PORVs set for 435 psig
3. PZR level <25% and PZR press < 100 psig

4. 1 PORV open
5. RCP starting criteria (ΔT_{RCS} & SG when below 350°F)

[+0.5] each; +1.5 maximum

REFERENCE

1. Zion: System Description 3-C-24.
2. Zion: Technical Specifications 3.3.2.G, pp. 82 and 83.

ANSWER 6.05 (2.00)

NOTE: Pump suctions or outflow only worth 0.5 pts. Must [illegible] Rod. for full credit

a. Maintain radiation levels below 2.5 mrem/hr at the Spent Fuel Pool (SFP) surface, during fuel movement. [+1.0]

b.
1. Refueling Water Storage Tank (RWST)
2. Boron Recycle System
3. Demineralized Flushing Water System
4. Service Water System
5. Local Fire Station
6. HUT
7. primary water
8. other unit RWST

Any four (4) [+0.25] each, +1.0 maximum.

REFERENCE

1. Zion: System Description 16-2.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 6.06 (1.50)

a. closed [+0.5]

b. prevent (resin channeling due to) excess flow through demin resin [+0.5]

c. HCV-182 (charging flow control valve) [+0.5]

REFERENCE

1. Zion: System Description, Chapter 5, pp. 5, 6 and 39 and Figure 5a-I-C1.

ANSWER 6.07 (2.00)

1. gland seal condensate bypass valves trip open

2. standby condensate/condensate booster pump starts

3. condensate booster pump recirculation valves trip shut

4. heater drain level control overrides (to allow full HDTP flow to go to the FWP)

[+0.5] each

REFERENCE

1. Zion: System Description, Chapter 25a, p. 44.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 6.08 (1.00)

1. manual
2. pressurizer high pressure
3. OT delta T
4. OP delta T
5. S/G feedwater mismatch
6. safety injection

Any three (3) [+0.33] each, +1.0 maximum.

REFERENCE

1. Zion: System Description 9-20-26.

ANSWER 6.09 (2.00)

1. PZR low pressure
2. PZR high level
3. RCP bus low voltage
4. turbine tripped
5. two-loop low flow

Any four (4) [+0.5] each, +2.0 maximum.

REFERENCE

1. Zion: System Description 9-27.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 7.01 (3.00)

a. avoids hydrazine saturation in demineralizers or loss of hydrazine from RCS

b. maintains acceptable boron concentration difference between RCS and PZR

c. maintains uniform RCS boron concentration [0.5] (partial credit given for Maintenance of boration [0.2])

d. maintains acceptable RCP labyrinth seal delta-P

e. avoids overloading the thermal barrier heat exchanger

f. maintains plant within safety analysis assumptions

[+0.5] each

REFERENCE

1. Zion: GOP-1 Precautions, J, S, V(P), F-F, H-H, and I-I.

ANSWER 7.02 (2.00)

a. Eliminate deviation [~~+0.3~~ +0.5] or reduce reactor power to no greater than 90% power [~~+0.4~~ 0.5] (and meet the applicable limits) ~~[+0.3]~~.

b. Immediately [~~+0.3~~] reduce load to 80% or less [~~+0.2~~ 0.2].

REFERENCE

1. Zion: GOP-3, p. 6 and 25.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 7.03 (2.00)

a. 1. Unit 1: 20" of Hg [+0.25]
Unit 2: 21" of Hg [+0.25]

2. 14 mils [+0.5]

3. 9.5 umhos/cm [+0.5]

b. possibility of electrical shock [+0.25] and/or severe arcing [+0.25]

REFERENCE

1. Zion: EOP-4, Turbine/Generator Emergency, pp. 3, 5, and 6.

ANSWER 7.04 (1.50)

1. fuel building ventilation routed through charcoal filters

2. containment purge isolation valves (RV01-04) closed (and fans tripped)

3. containment relief isolation valves (RV-5 and 6) closed

[+0.5] each

REFERENCE

1. Zion: EOP-6, Fuel Handling Emergency, p. 5.

ANSWER 7.05 (2.00)

1. RCS subcooling [+0.5] - less than 30 deg F [+0.5]
2. PZR level [+0.5] - less than 4% [+0.5]

REFERENCE

1. Zion: Foldout page for E-1 Series Procedures.

ANSWER 7.06 (2.00)

a. 1. existence of secondary-to-atmosphere break [+0.5]
2. existence of primary-to-secondary break [+0.5]

b. If SG A or D is ruptured [+~~0.3~~ 0.5], its supply line to the turbine-driven AFW pump cannot be closed [+~~0.3~~ 0.2], and at least one motor driven AFW pump running [+0.4].

REFERENCE

1. Zion: E-2, Faulted Steam Generator Isolation, p. 2.

2. Zion: E-3, Steam Generator Tube Rupture, pp. 4 and 6.

ANSWER 7.07 (2.50)

a. None (status trees are monitored for information only in ECA-0.0) [+0.5]

b. 1. containment pressure >/= 5 psig [+0.5]
containment radiation >/= 10**5 R/hr [+0.5]

2. containment pressure -- yes [+0.5]
containment radiation -- no [+0.5]

REFERENCE

1. Zion: ECA-0.0, Loss of All AC Power, p. 2.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 8.01 (1.50)

a. Five (5) members at all times [~~+0.5~~ +1.0] (and shall not include the minimum shift crew necessary for safe shutdown of the plant or personnel required for other essential functions during a fire emergency) [~~+0.5~~].

b. Shift shortage caused by sudden sickness or home emergency [+0.5].

REFERENCE

1. Zion: Technical Specifications, 6.0, pp. 300 and 331, and Table 6.1.2.

ANSWER 8.02 (1.50)

1. incore thimbles are in the reactor vessel

2. incore detectors are taken out of service

3. incore detectors are in the storage position or are inserted in the reactor vessel

NOTE: Surveys and permission are acceptable alternative answers.
[+0.5] each

REFERENCE

1. Zion: ZAP 5-51-16, p. 2.

ANSWER 8.03 (1.00)

(c.) [+1.0]

REFERENCE

1. Zion: ZAP 3-51-4, pp. 3, 4 and 8.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 8.04 (2.00)

a. shift engineer
b. shift foreman
c. shift engineer
d. shift engineer

[+0.5] each

REFERENCE

1. Zion: ZAP 1-51-1, pp. 4 through 6.

ANSWER 8.05 (2.50)

a. One (1) gpm total leakage for all S/Gs [+0.5]

   500 gpd per S/G [+0.5]

b. One (1) gpm--ensures the dosage contribution from the tube leakage will be limited to a small fraction of the Part 100 limits in event of a SGTR or SLB [+0.75]

   500 gpd--ensures that S/G tube integrity is maintained in the event of a steam line rupture as under LOCA conditions [+0.75]

REFERENCE

1. Zion: Technical Specifications, p. 98a.

ANSWER 8.06 (2.50)

a. containment radiation level [+0.5]

b. 1. containment radiation level
   2. containment pressure
   3. containment isolation
   4. reactor water level
   5. radioactive release in progress

   Any four (4) [+0.5] each, +2.0 maximum.

REFERENCE

1. Zion: EPIP 100-1, pp. 7 and 8.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 8.07 (2.00)

a. 1. shutdown margin >/= 10% delta k/k [+0.5]
2. T-ave </= 140 deg F [+0.5]

b. sample RCS for CB >/= minimum monitor RCS exit temperature [+0.5]

c. once a shift [+0.5]

REFERENCE

1. Zion: Technical Specifications, 3.13.3.B, p. 245.

ANSWER 8.08 (2.00)

a. True
b. True
c. True
d. False

[+0.5] each

REFERENCE

1. Zion: ZAP 5-51-4.

EQUATION SHEET

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

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

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

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

$P = P_o 10^{(SUR)(t)}$ $\quad P = P_o e^{t/T}$ $\quad SUR = \frac{26.06}{T}$ $\quad T = \frac{(B-p)t}{p}$

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

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

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

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

MASTER COPY

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR REQUALIFICATION EXAMINATION

FACILITY: ZION 1&2

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 86/10/14

EXAMINER: DEFFERDING, L. / GRUEL, R.

CANDIDATE: ANSWER KEY

INSTRUCTIONS TO CANDIDATE:

Read the attached instruction page carefully. This examination replaces the current cycle facility administered requalification examination. Retraining requirements for failure of this examination are the same as for failure of a requalification examination prepared and administered by your training staff. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up four (4) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
~~15.00~~ 14	~~25.00~~ 23.3			1.	PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
15.00	~~25.00~~ 42			2.	PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
15.00	~~25.00~~ 43			3.	INSTRUMENTS AND CONTROLS
15.00	~~25.00~~ 42			4.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
~~60.00~~ 59					Totals

Final Grade

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

Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

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

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

6. Use only the paper provided for answers.

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

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

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

10. Skip at least three lines between each answer.

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

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

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

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

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

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

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

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

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

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

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

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

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

QUESTION 1.01 (1.00)

An ECP calculation reveals that criticality should be achieved when 3000 pcm has been added to the core. A boron dilution of 150 ppm B (1500 pcm) is planned, followed by control rod withdrawal to criticality. The initial count rate is 50 cps. WHAT is the expected count rate after the 150 ppm B boron dilution? (1.0)

QUESTION 1.02 (3.00)

Zion Unit 1 is operating at 100% power with 450 ppm boron. Reactor power is to be decreased to 85%. Initial Bank D rod position is 200 steps.

a. Use Figures 1.1 and 1.2 to DETERMINE the final rod position if boron concentration is to remain unchanged. (2.0)

b. WOULD a SMALLER or LARGER rod insertion be required if the same power maneuver was performed at EOL? WHY? (1.0)

QUESTION 1.03 (2.00)

ANSWER the following TRUE or FALSE.

a. Equilibrium samarium concentration is a function of power. (0.5)

b. Xenon concentration initially increases after a reactor trip. (0.5)

c. Equilibrium xenon reactivity is dependent upon core burnup. (0.5)

d. Equilibrium xenon concentration after a trip is a function of the previous power level. (0.5)

QUESTION 1.04 (1.00)

Zion Unit 1 is either undermoderated or overmoderated at power operation. STATE WHICH and WHY it was so designed. (1.0)

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

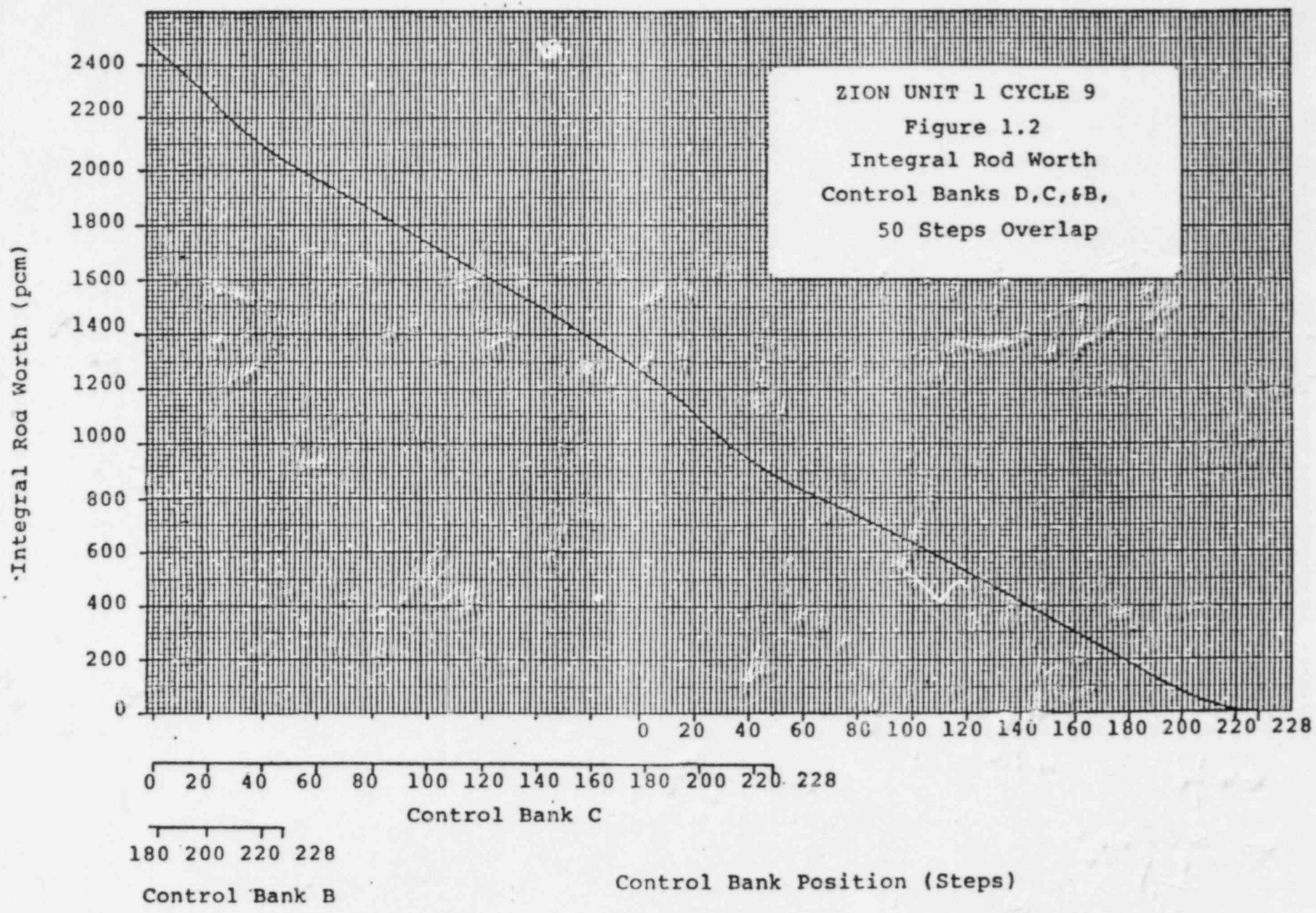
ZION UNIT 1 CYCLE 9
Figure 1.2
Integral Rod Worth
Control Banks D,C,&B,
50 Steps Overlap
Integral Rod Worth (pcm)
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180 200 220 228
0 20 40 60 80 100 120 140 160 180 200 220 228
Control Bank C
180 200 220 228
Control Bank B
Control Bank Position (Steps)

FIGURE 1.1

ZION UNIT 1 CYCLE 9

Figure 1.4

Total Power Defect (Doppler & Moderator)

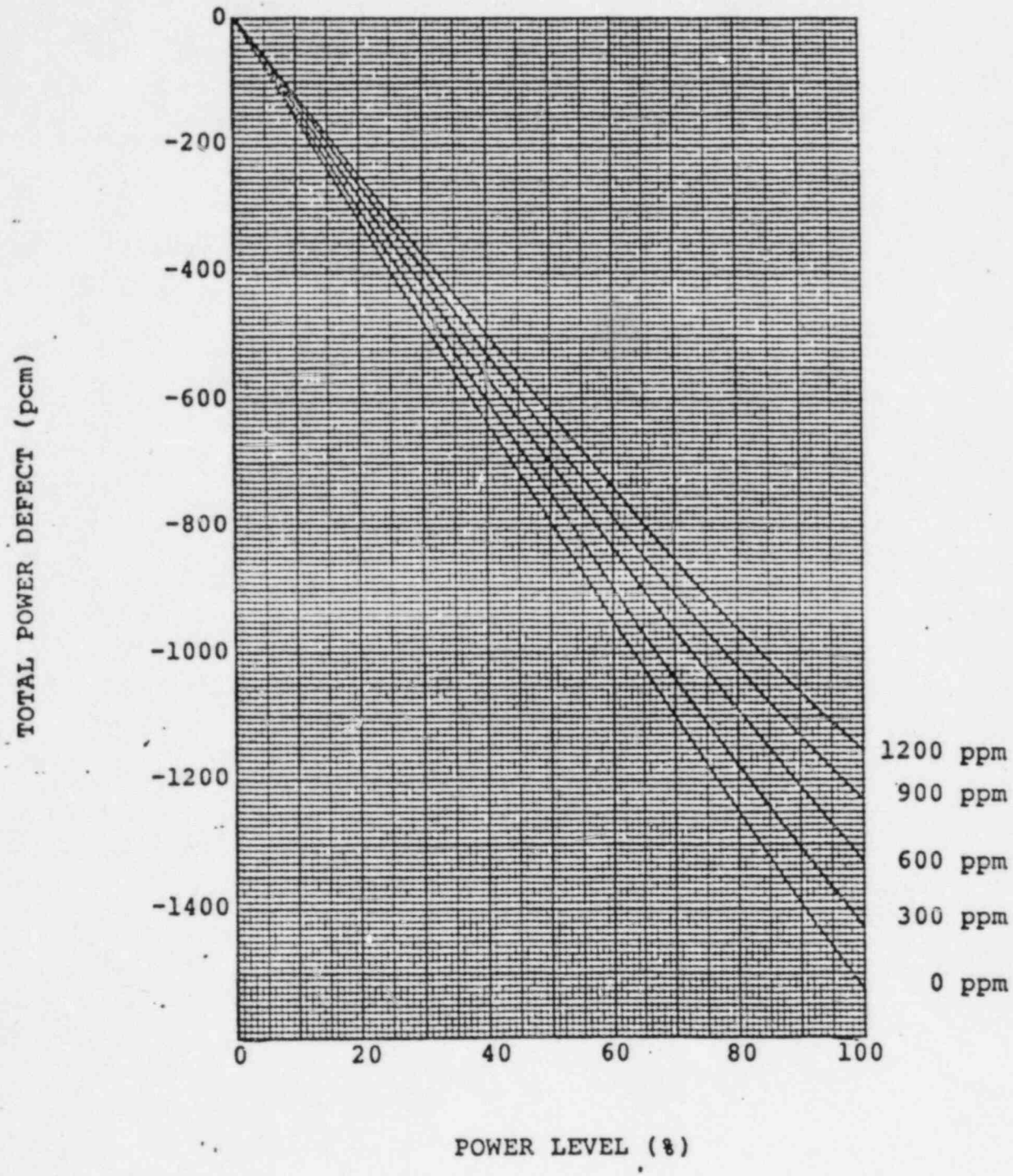

FIGURE 1.2

QUESTION 1.05 (2.00)

LIST the four (4) reactivity contributions considered when determining shutdown reactivity as part of the shutdown margin determination. (2.0)

QUESTION 1.06 (1.00)

The margin to DNB: (1.0)

(a.) decreases with increasing RCS flow
(b.) increases with increasing reactor power
(c.) increases with increasing pressurizer pressure
(d.) increases with increasing T-ave

QUESTION 1.07 (1.00)

A relief valve (to the atmosphere) on a pipe opens at 885 psig. The temperature of the exhausted steam is 320 deg F. The temperature of the fluid (water or steam) within the pipe is approximately: (1.0)

(a.) 540 deg F
(b.) 400 deg F
(c.) 320 deg F
(d.) 212 deg F

QUESTION 1.08 (1.50)

Letdown water (75 gpm) at 557 deg F enters the regenerative heat exchanger and exits at 290 deg F. ASSUMING normal, steady-state, at power operation (total charging flow of 87 gpm at 115 deg F), WHAT is the temperature of the charging water entering the RCS from the regenerative heat exchanger? SHOW all work and STATE all assumptions. (1.5)

QUESTION 1.09 (1.50)

LIST the three (3) indications that show natural circulation is established. (1.5)

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

QUESTION 1.10 (1.00)

Deleted

Two (2) identical centrifugal pumps are connected in parallel in a fluid system. If initially only one (1) pump is operating, and then the second pump is started, WHICH one of the following is correct? (1.0)

(a.) total discharge pressure remains the same
(b.) total system flow doubles
(c.) system head loss curve changes
(d.) minimum required NPSH decreases

(***** END OF CATEGORY 01 *****)

QUESTION 2.01 (2.50)

a. WHAT three (3) different parameters are used for input to the Main Feedwater Pump Net Positive Suction Head (FWP NPSH) Control System? Be specific. (1.0)

b. If the available FWP NPSH decreases to 275 psig, an alarm sounds. LIST three (3) of the other four (4) actions that automatically occur when a low FWP suction pressure condition exists. (1.5)

QUESTION 2.02 (2.00)

a. With the Component Cooling Water Pump Cooling Switch in the "AUTO" position, WHAT will automatically start the standby pump? (Setpoints not required.) (1.0)

b. Under WHAT conditions will component cooling water automatically be isolated to the RCPs? (0.5)

c. WHAT signal will isolate the CCW return water from the Excess LDHX by closing the valve 1AOV-CC9437? (Setpoints not required.) (0.5)

QUESTION 2.03 (1.00)

You are conducting a recovery from a reactor trip during which all reactor coolant pumps tripped. Conditions have been restored to the point where reactor coolant pumps can be started. WHICH pump should you start first and WHY? (1.0)

QUESTION 2.04 (2.50)

a. The RCP No. 1 seal water return flow to the CVCS is isolated upon containment isolation. WHAT provision is made for maintaining seal leakoff after the isolation valves close? (1.0)

b. WHY is there a requirement to have the primary loop pressure greater than 325 psig before starting an RCP? (1.0)

c. WHAT device is used to provide back pressure on the RCP number 2 seal? (0.5)

(***** CATEGORY 02 CONTINUED ON NEXT PAGE *****)

QUESTION 2.05 (1.50)

With regard to ESF buses: (-147, -148, -149)

a. LIST the three (3) available power supplies to ESF buses. (1.0)

b. By definition, WHAT constitutes a station blackout? (0.5)

QUESTION 2.06 (1.50)

EXPLAIN how all the ECCS pumps are protected from overheating when the pumps are in a minimum flow condition. Be specific. (1.5)

QUESTION 2.07 (2.00)

Regarding the CVCS valve TCV-129 (3-way temperature control valve):

a. STATE WHEN and WHY its controller would automatically go to the divert position. (1.0)

b. By procedure, WHEN and WHY would the controller be placed in the manual divert position to bypass the normal flow paths? (1.0)

QUESTION 2.08 (2.00)

In the Safeguard Actuation System there are five (5) separate actuation signals. LIST the four (4) signals (omit manual) and the accidents they are designed to mitigate. (2.0)

(***** END OF CATEGORY 02 *****)

QUESTION 3.01 (1.00)

WHICH of the following core parameters does the OT delta T protective circuit prevent exceeding? (1.0)

(a.) power density
(b.) departure from nucleate boiling
(c.) total core power
(d.) linear power generation rate

QUESTION 3.02 (2.00)

Unit 1 is operating at 45% power with all systems in automatic control. For each of the following conditions, GIVE the direction of initial rod motion, if any, and EXPLAIN WHY there is a rod motion, if any.

a. A steam generator Atmospheric Power Relief Valve fails open. (1.0)

b. The lower detector of the power range channel N-44 fails low. (1.0)

QUESTION 3.03 (1.00)

The three (3) input signals to the Steam Generator Water Level Control are: (1.0)

(a.) T-ave, compensated feed flow, uncompensated steam flow
(b.) feed flow, compensated steam flow, water level error
(c.) compensated feed flow, water level, compensated steam flow
(d.) uncompensated feed flow, compensated steam flow, water level

QUESTION 3.04 (1.00)

Protective signals that initiate Reactor Protection and Engineered Safety Features use a "de-energize to operate" bistable principle (they actuate on loss of power). STATE the one (1) protective feature that does not use this principle and EXPLAIN WHY. (1.0)

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

QUESTION 3.05 (2.00)

INDICATE which of the Excore Nuclear Instrumentation Ranges (SOURCE, INTERMEDIATE, POWER, or NONE) will correctly match the following statements. More than one may apply to each. (2.0)

a. Provides a direct input to the Rod Control System.

b. Has a reactor trip function that is blocked at some time between startup and full power operation.

c. Its detector operation is unaffected by gamma radiation.

d. Utilizes a Boron-10 coating in its detectors.

QUESTION 3.06 (1.50)

a. LIST the actuation signals that will cause auto-start of the Turbine-Driven AFW pump. (1.0)

b. WHAT supplies the cooling water for the Turbine-Driven AFW pump? (0.5)

QUESTION 3.07 (2.00)

Regarding the Safeguards Sequence Timer:

a. WHAT is the basic purpose of this device? (0.5)

b. LIST five (5) major safety related components which are controlled by the Timer during a blackout with safety injection. (1.5)

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

QUESTION 3.08 (2.00)

If the Volume Control Tank (VCT) level instrument that controls Auto Makeup to the VCT (Level Channel LT-112) fails

a. high, WHAT (if anything) will prevent eventual emptying of the VCT? (1.0)

b. low, WILL the charging pump suction automatically shift over to the RWST? EXPLAIN. (1.0)

QUESTION 3.09 (2.00)

Regarding Main Steam Isolation Valve (MSIV) control:

a. WHAT conditions result in automatic closure of the MSIVs? (1.0)

b. EXPLAIN how the valves may be manually closed (from the control room) if automatic closure does not occur. (0.5)

c. Once closed, (automatically or manually) HOW may the valves be reopened? (0.5)

QUESTION 3.10 (.50)

LIST the radiation monitor(s) that upon reaching high alarm could cause ONLY containment ventilation valves (RV 0001 through 4) to isolate. (0.5)

(***** END OF CATEGORY 03 *****)

QUESTION 4.01 (2.00)

GOP-1 lists several precautions. STATE the concern which is addressed by each of the following.

a. When the RCS is solid and on RHR letdown, place PCV-131 in Manual prior to starting an RHR pump. (0.5)

b. Periodically opening the pressurizer spray valves during heatup. (0.5)

c. Adjusting VC-HCV-182 after a significant charging flow change. (0.5)

d. Leaving the RCP seal bypass valve closed during a loss of injection water. (0.5)

QUESTION 4.02 (2.00)

According to GOP-3, WHAT action must be taken for each of the following during operation at 100% power?

a. Delta-I deviates from the target band (1.0)

b. An Intercept Stop Valve inadvertently closes (1.0)

QUESTION 4.03 (1.50)

LIST three (3) symptoms common to an RCS leak at any location. (1.5)

QUESTION 4.04 (1.00)

If the control rods are in auto and fail to correct a T-ave/T-ref deviation, LIST two (2) means that can be used to correct the deviation. (1.0)

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

QUESTION 4.05 (1.50)

In the event of a fuel handling emergency, WHAT valve/system lineups should immediately be verified? (1.5)

QUESTION 4.06 (2.00)

After SI has been terminated, under WHAT conditions should charging and SI pumps be restarted? Include parameter AND setpoints. (2.0)

QUESTION 4.07 (2.50)

If an ATWS occurs, the operator is directed by FR-S.1 to emergency borate. LIST the five (5) steps that must be accomplished, IN ORDER, before BIT flow is verified. (2.5)

QUESTION 4.08 (2.50)

ECA-0.0 is entered due to a loss of all AC power.

a. WHAT priority (color) of a Functional Restoration Procedure allows exit from ECA-0.0? (0.5)

b. 1. DEFINE the conditions under which ADVERSE CONTAINMENT exists. (1.0)

2. If the ADVERSE CONTAINMENT parameters decrease below setpoint, can normal values subsequently be used? (1.0)

(***** END OF CATEGORY 04 *****)
(********** END OF EXAMINATION **********)

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 1.01 (1.00)

(Since the amount of reactivity inserted is one-half of the total amount needed to reach criticality,) the count rate should double, or about 100 cps. [+1.0]

OR

For rho = K-1 (valid approximation)

$$CR1/CR0 = (1-K0)/(1-K1)$$
$$= (1-(rho0 + 1))/(1-(rho1 + 1))$$
$$= rho0/rho1$$
$$= 2$$

CR1 = 2*CR0 = 100 cps (actual is 98.54 cps) [+1.0]

REFERENCE

1. Generic: Westinghouse Fundamentals of Nuclear Reactor Physics, pp. 5.22 through 5.29 and 8.39 through 8.41.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 1.02 (3.00)

a. From Figure 1.1:

defect at 100% power: -1375 pcm (+/- 5 pcm acceptable)
defect at 85% power: -1195 pcm (+/- 5 pcm acceptable)

Therefore, a reactivity change of 180 pcm (+/- 10 pcm) is required. [+1.0]

From Figure 1.2:

rod worth at 200 steps: 80 pcm

required rod worth: 260 pcm (180 + 80) (250 - 270 pcm acceptable)

This corresponds to a rod position of 168 steps (166 - 170 acceptable) [+1.0]

b. Larger [+0.5] because of the increase in power defect at EOL [+0.5] (which outweighs the increase in rod worth).

Note: Figures 1.1 and 1.2 are Figures 1.2 and 1.4, respectively.

REFERENCE

1. Zion: Station Curve Book, Figures 1.2 and 1.4.

ANSWER 1.03 (2.00)

a. False
b. True
c. ~~True~~ False (concentration changes with life, but not reactivity)
d. False ; TRUE with appropriate explanation

[+0.5] each

REFERENCE

1. Generic: Westinghouse Reactor Core Control, pp. 4-31, 4-21, 4-18, and 4-22.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 1.04 (1.00)

Undermoderated [+0.5] ensures MTC is negative [+0.5].

REFERENCE

1. Generic: Westinghouse Reactor Core Control, p. 3-15.

ANSWER 1.05 (2.00)

1. xenon
2. rods
3. temperature
4. boron

[+0.5] each

REFERENCE

1. Generic: Westinghouse Reactor Core Control, p. 9-8.

ANSWER 1.06 (1.00)

(c.) [+1.0]

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 13-23 and 13-24.

ANSWER 1.07 (1.00)

(a.) [+1.0]

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 10-67 through 10-71.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 1.08 (1.50)

Q-dot(letdown) = Q-dot(charging) [+0.5]

m-dot(l) delta T(l) = m-dot(c) delta T(c)
delta T(c) = delta T(l) (m-dot(l)/m-dot(c))
m-dot(c) = 55 gpm (charging less 32 gpm for RCP seals) [+0.5]

delta T(c) = 267 deg F (75/55) = 364 deg F
Outlet temperature is therefore 115 + 364 = 479 deg F [+0.5]

REFERENCE

1. Westinghouse: Thermal-Hydraulic Principles, pp. 5-44 through 5-46.

ANSWER 1.09 (1.50)

1. constant or decreasing but less than full-load delta-T across the reactor core
2. core outlet temperatures are constant or decreasing
3. constant steam generator level with a constant auxiliary feedrate and a constant or decreasing steam pressure
4. > 30°F subcooling
5. core inlet temp at sat temp for SG press

[+0.5] each; 1.5max

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 14-27.

ANSWER 1.10 (1.00)

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(d.) [+1.0]

REFERENCE

1. Generic: Westinghouse Thermal-Hydraulic Principles, pp. 10-46 through 10-58.

ANSWER 2.01 (2.50)

a. 1. FWP flowrate (separate for each pump)
2. feed suction header temperature
3. feed suction header pressure

[+0.33] each

b. 1. gland seal condensate bypass valves trip open
2. standby condensate/condensate booster pump starts
3. condensate booster pump recirculation valves trip shut
4. heater drain level control overrides (to allow full HDTP flow to go to the FWP)

Any three (3) [+0.5] each, +1.5 maximum.

REFERENCE

1. Zion: System Description 25a-44.

ANSWER 2.02 (2.00)

a. low pump discharge pressure (80 psig)
blackout sequence
SI sequence

[+0.33] each

b. phase "B" isolation [+0.5]

c. phase "A" isolation (SI) [+0.5]

REFERENCE

1. Zion: System Description 15, pp. 10-11, 12, 30 and 31.

ANSWER 2.03 (1.00)

RCP B or D [+0.5] - they supply normal spray flow [+0.5]

REFERENCE

1. Zion: System Description 3C.

ANSWER 2.04 (2.50)

a. a pressure relief valve (1VC8121) to the PRT [+1.0]

b. to provide adequate delta P across the No. 1 seal to ensure there is a gap between the rotating and nonrotating member [+1.0]

c. the stand pipe [+0.5]

REFERENCE

1. Zion: System Description 3 and 12, Drawing M54.

ANSWER 2.05 (1.50)

a. 1. main feed from associated service bus (SAT or UAT)

2. reserve feed from opposite units nonESF bus (241 bus)

3. emergency feed from the associated D/G (0-147, 1A-148, 1B-149)

[+0.33] each

b. UV on 2/3 service buses which feed ESS buses (142, 143, 144) [+0.5]

REFERENCE

1. Zion: System Description 1-2 and 52.

ANSWER 2.06 (1.50)

The RHR pumps have a mini-flow valve that will open (when flow is below 1000 gpm and will maintain a minimum flow of 600 gpm). [+0.5]

SI pumps recirculation valves are open and flow is recirculated to the RWST [+0.5]

The charging pumps have recirculation valves that are left open. This sends flow back to the VCT through the Seal Water Hx where it is cooled. [+0.5]

REFERENCE

1. Zion: System Description 12a-7, 11.

2. Zion: System Description 5a-6.

3. Zion: System Description 10-5.

ANSWER 2.07 (2.00)

a. TCV-129 diverts flow around the demins at approx. 145 deg F [+0.5] to protect the resin from breaking down due to high temperatures [+0.5].

b. TCV-129 would be placed in divert when hydrazine is added to the system [+0.5]. This keeps the demins from displacing the hydrazine with the chlorides that are in the demins [+0.5].

REFERENCE

1. Zion: System Description 5a-4, 5, 17 and 57.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 2.08 (2.00)

1. PZR low pressure/LOCA, steam break
2. steam line delta P/steam break upstream of check valve
3. high steam flow/steam break downstream of check valve with Lo-Lo T-ave or Low steam line pressure
4. containment Hi pressure/LOCA, steam break inside containment

[+0.5] each

REFERENCE

1. Zion: System Description 126-192.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 3.01 (1.00)

(b.) [+1.0]

REFERENCE

1. Zion: System Description 9-22.

ANSWER 3.02 (2.00)

a. Steam flow increases causing increased removal of heat from the RCS, reducing T-ave [+0.5]. T-ave - T-ref deviation causes rod control circuit to withdraw rods to restore T-ave [+0.5].

b. This causes decreased N-44 output. Rod control sees auctioneered high nuclear power [+0.5], so no rod movement [+0.5].

REFERENCE

1. Zion: System Description 8-1 and Figure 8a-I-C1.

ANSWER 3.03 (1.00)

(b.) [+1.0]

REFERENCE

1. Zion: System Description 25, 6 through 203.

ANSWER 3.04 (1.00)

High-high containment pressure [+0.5] to prevent inadvertent initiation of containment spray if power is lost [+0.5].

REFERENCE

1. Zion: System Description 126-3.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 3.05 (2.00)

a. intermediate and power
b. source, intermediate, and power
c. none
d. intermediate and power

[+0.5] each

REFERENCE

1. Zion: System Description, 6a, 6b and 6c.

ANSWER 3.06 (1.50)

a. 1. SI
2. BO
3. UV on 2/4 RCP buses
4. 2/3 Lo-Lo level on 2/4 S/Gs

[+0.25] each

b. bleed from 5th stage of the pump [+0.5] (self cooled acceptable)

REFERENCE

1. Zion: System Description 12C to 2&7.

ANSWER 3.07 (2.00)

a. (Connects major safeguards' loads to their respective ESF buses in a programmed sequential manner, thus) avoiding the severe voltage/frequency fluctuations and transient overload condition (that would accompany simultaneous application of these loads to the D/Gs). [+0.5]

b. 1. centrifugal charging pumps
2. SI pumps
3. RHR pumps
4. AFW pumps
5. SW pumps
6. RCFCs
7. CCW pumps
8. [redacted] CS pumps (if Hi-Hi containment pressure)

Any five (5) [+0.3] each, +1.5 maximum.

REFERENCE

1. Zion: System Description 31-61 and Figure 31-II-C5.

ANSWER 3.08 (2.00)

a. Nothing short of operator intervention in response to a low-level alarm from the other VCT level channel and observation of the level indicators for the two channels. [+1.0]

b. No [+0.5]. Both VCT level channels must sense a low-level condition in order for the transfer to occur (2/2 coinc. req.) [+0.5].

REFERENCE

1. Zion: System Description 5a-57.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 3.09 (2.00)

a. Hi-Hi containment pressure (>23 psig) (2/4) [+0.5]

(2/4) Hi steam flow coincident with (2/4) Lo-Lo T-ave (<540 deg F) or (2/4) low steam line pressure (<600 psig) [+0.5]

b. by operating the individual actuate pushbuttons for each valve located on the safeguards section of the MCB (ICB12) [+0.5]

c. by turning the individual loop test switch controls for each valve to the "reset" position (also on the safeguards section of the MCB) [+0.5] or switch on MCB

REFERENCE

1. Zion: System Description 21a-28.

ANSWER 3.10 (.50)

purge monitor PR-09A,B,C [+0.5]

REFERENCE

1. Zion: System Description 11-10 and 13a.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 4.01 (2.00)

a. to prevent an inadvertent RCS pressure reduction

b. maintains acceptable boron concentration difference between RCS and PZR

c. maintains acceptable RCP labyrinth seal delta-P

d. avoids overloading the thermal barrier heat exchanger

[+0.5] each

REFERENCE

1. Zion: GOP-1 Precautions, W, S, ~~V(F)~~, F-F, and H-H, ~~and I-I~~.

ANSWER 4.02 (2.00)

a. Eliminate deviation [+~~0.3~~ 0.5] or reduce reactor power to no greater than 90% power [+~~0.3~~ 0.5] (and meet the applicable limits) ~~[±0.3]~~

b. Immediately [+~~0.3~~ 0.5] reduce load to 80% or less [+~~0.7~~ 0.2].

REFERENCE

1. Zion: GOP-3, p. 6 and 25.

ANSWER 4.03 (1.50)

1. Increased VCT makeup frequency
2. Increased charging flow during steady-state operation
3. Slowly decreasing PZR level
4. Pressurizer back-up heaters energized in auto

Any three (3) [+0.5] each, +1.5 maximum.

REFERENCE

1. Zion: AOP-1, Excessive RCS Leakage, p. 2.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 4.04 (1.00)

1. manual rod control
2. adjust turbine load
3. change boron concentration

Any two (2) [+0.5] each, +1.0 maximum.

REFERENCE

1. Zion: EOP-2, Rod Control System Malfunction, p. 4.

ANSWER 4.05 (1.50)

1. fuel building ventilation routed through charcoal filters
2. containment purge isolation valves (RV01-04) closed (and fans tripped)
3. containment relief isolation valves (RV-5 and 6) closed

[+0.5] each

REFERENCE

1. Zion: EOP-6, Fuel Handling Emergency, p. 5.

ANSWER 4.06 (2.00)

1. RCS subcooling [+0.5] - less than 30 deg F [+0.5]
2. PZR level [+0.5] - less than 4% [+0.5]

REFERENCE

1. Zion: Foldout page for E-1 Series Procedures.

ANSWERS -- ZION 1&2 -86/10/14-DEFFERDING, L.

ANSWER 4.07 (2.50)

1. Start both centrifugal charging pumps
2. Close charging flow control valve (FCV-121)
3. Close BIT to BAT isolation valves (AOV-SI8870A and B)
4. Close BAT pumps to BIT isolation valve (AOV-SI8883)
5. Open BIT Inlet and Outlet isolation valves (MOV-SI8803A and B, 8801A and B)

[+0.5] each

REFERENCE

1. Zion: FR-S.1, Response to Nuclear Power Generation/ATWS, p. 3.

ANSWER 4.08 (2.50)

a. None (status trees are monitored for information only in ECA-0.0) [+0.5]

b. 1. containment pressure >/= 5 psig [+0.5]
containment radiation >/= 10**5 R/hr [+0.5]

2. containment pressure -- yes [+0.5]
containment radiation -- no [+0.5]

REFERENCE

1. Zion: ECA-0.0, Loss of All AC Power, p.2.