

W3SES Examination Report
No. 50-382/OL-86-03

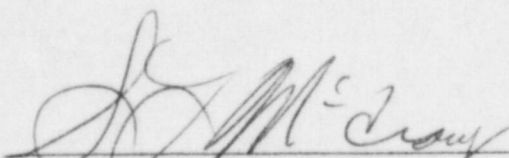
Docket No: 50-382

License No.: NPF-38

Licensee: Louisiana Power & Light
142 Delaronde Street
New Orleans, Louisiana 70174

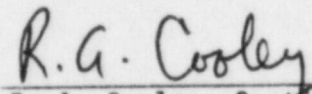
Examinations administered at Waterford 3 Steam Electric Station

Chief Examiner:


S. L. McCrory, Lead Examiner

9/25/86
Date

Approved by:


R. A. Cooley, Section Chief

10/1/86
Date

Summary

Examinations conducted on August 19-21, 1986

Written and operating examinations were administered to eleven (11) Senior Reactor Operator candidates, operating examinations only to one (1) Senior Reactor Candidate and one (1) Instructor Certification, and written examinations only to five Reactor Operator candidates. All candidates passed these examinations except one (1) Senior Reactor Operator failed the operating examination.

B610160087 861006
PDR ADOCK 05000382
V PDR

Report Details

I. Examination Results

SRO candidates

Total	Pass	Fail	%
13	12	1	92

RO Candidates

Total	Pass	Fail	%
5	5	0	100

II. Examiners

S. L. McCrory, Chief Examiner
D. Graves
R. Maines
R. Cooley

III. Examination Report

This Examination Report is composed of the sections listed below.

Examination Review Comment Resolution

Exit Meeting Minutes

W3SES Examination Key (SRO Questions and Answers)

Performance results for individual examinees are not included in this report because examination reports are placed in NRC's Public Document Room as a matter of course. Individual results may be retained in the NRC Region office during the period that the facility is evaluated as unsatisfactory but are not subject to public disclosure.

A. Examination Review Comment Resolution

In general, editorial comments or changes made during the examination, the examination review, or subsequent grading reviews are not addressed by this resolution section. This section reflects resolution of substantive comments made during the examination review. The modifications discussed below are included in the master examination key which is provided elsewhere in this report as are all other changes mentioned above but not discussed herein. Attachment 1 is the facility comments on the examination. Unless otherwise indicated in this section, the facility comments were incorporated into the answer key.

COMMENTS

1. 2.08 Delete from examination.
Resp. REJECT. The system design and operation was discussed with a member of the training staff and the answer key was modified to reflect correct system design and operation.
2. 5.02b Delete present answer and replace with: "Maintain ASI close to expected ESI since ASI will shift positive due to density (temperature) effects on flux."
Resp. The scope of acceptable answers was expanded to include other reasonable justifications for maintaining positive ASI during startup.
3. 7.10 Delete question from examination.
Resp. REJECT. Full credit was given for just stating that high winds and hail are to be anticipated when a Severe Thunderstorm Warning is issued. For the declaration of a severe weather condition to have any value, it must convey certain expectations of what kind of weather phenomena to anticipate. Since the declaration of Severe Thunderstorm Warning can be fairly common during certain seasons, it is reasonable for the senior operators to appreciate the significance of the declaration.
4. 7.12 Delete question from examination.
Resp. REJECT. While the facility is obligated to instruct its employees in the hazards of radiation and the methods available to reduce exposure, it is the responsibility of each individual to act on this information to reduce personal exposure. It is quite possible that it would be necessary for an individual seek treatment to mitigate exposure effects because HP personnel were not readily at hand to advise the individual of the need for treatment. If the individual is to make good decisions concerning the urgency of seeking treatment, he or she must have a feel for the time dependent aspects of his or her decisions. This question was graded liberally, but it was apparent that most of the senior operators have no feel at all of the time dependent nature for seeking this type of treatment.
5. 8.09b Award full credit for the first part of the answer only.
Resp. REJECT. The point value was redistributed .75/.25 to place more emphasis on the first part of the answer. However, the second part is considered by NRC to be an essential element when contemplating this type of action.

B. Exit Meeting Summary

At the conclusion of the examination period, the examiners met with the members of the facility staff to discuss the results of the examinations. The following personnel were present for the exit meeting:

NRC
S. McCrory
R. Maines

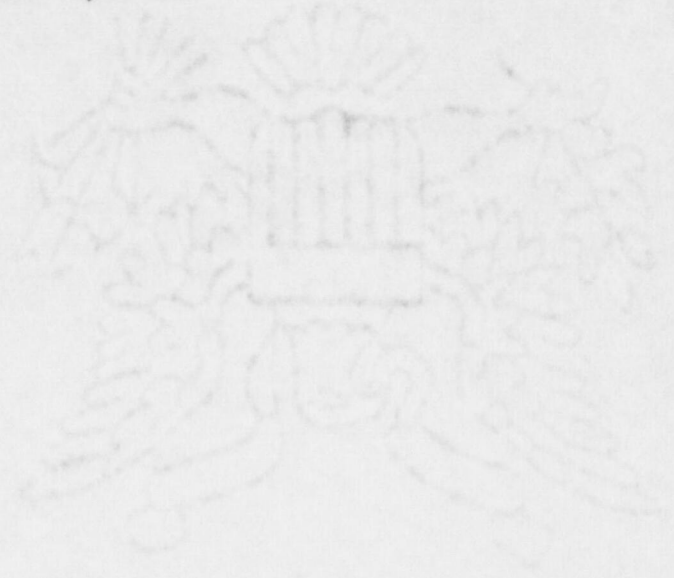
UTILITY
R. Barkhurst
D. Packer
C. Toth
L. Myers
D. Clark

NRC informed the facility staff that no generic weaknesses were identified during the course of these examinations. It was noted, however, that the non-shift candidates were considerably less familiar with the plant in general than candidates who routinely performed shift functions. Additionally, the system for controlling keys for which the shift supervisor is responsible appeared to have weaknesses which prevented prompt recognition of lost or stolen keys.

C. W3SES Examination Key

Date Administered: 8/19/86

Type of Examination: Reactor Operator
 Senior Reactor Operator



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

FACILITY: WATERFORD 3
 REACTOR TYPE: PWR-CE
 DATE ADMINISTERED: 86/08/19
 EXAMINER: MCCRORY, S.
 CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

CATEGORY	% OF	CANDIDATE'S	% OF	
VALUE	TOTAL	SCORE	VALUE	CATEGORY
25.00	25.00	_____	_____	5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.00	_____	_____	6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
25.00	25.00	_____	_____	7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.00	_____	_____	8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
100.00		_____		Totals
		Final Grade		

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

Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.
2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.
3. Use black ink or dark pencil only to facilitate legible reproductions.
4. Print your name in the blank provided on the cover sheet of the examination.
5. Fill in the date on the cover sheet of the examination (if necessary).
6. Use only the paper provided for answers.
7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.
8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.
9. Number each answer as to category and number, for example, 1.4, 6.3.
10. Skip at least three lines between each answer.
11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.
12. Use abbreviations only if they are commonly used in facility literature.
13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.
14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.
15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.
16. If parts of the examination are not clear as to intent, ask questions of the examiner only.
17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

{1} Exam questions on top.

{2} Exam aids - figures, tables, etc.

{3} Answer pages including figures which are part of the answer.

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

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

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

QUESTION 5.01 (1.00)

Why is the shutdown requirement greater in modes 1-4 than in mode 5? (1.0)

QUESTION 5.02 (2.00)

- a. Define a POSITIVE ASI. (1.0)
- b. Why is it desirable to maintain a slightly positive ASI during plant startup initial power ascension if the ESI is not available and the plant is not yet at equilibrium? (1.0)

QUESTION 5.03 (3.00)

List five (5) physical factors which change over core life and affect the heat transfer capability of the fuel and the full power center line temperature. Indicate whether each factor will tend to INCREASE or DECREASE center line temperature over the life of the core. (3.0)

QUESTION 5.04 (3.00)

The plant is at 100% power, ARO, rod control in MANUAL and the core age is 268 EFPD. With NO operator action, explain the effect of increasing the boron concentration by 10 ppm. Indicate the final plant parameters of temperature, pressure, and power. What is the final boron concentration (assume ideal core)? Use figures provided to assist calculations. Show all work for full credit. (3.0)

QUESTION 5.05 (1.50)

If after operating in natural circulation for 2 hours, an operator error causes a COMPLETE LOSS of natural circulation flow, how will the following parameters change (INCREASE, DECREASE, or REMAIN THE SAME)? Briefly EXPLAIN your answer. (Assume no further operator action.) (1.5)

- a. Core delta T
- b. Core thermocouple temperature
- c. Steam generator pressure

QUESTION 5.06 (2.00)

Describe HOW and WHY 100% equilibrium Xenon REACTIVITY WORTH and CONCENTRATION change, if at all, as a function of core age. (2.0)

QUESTION 5.07 (1.00)

Although the U 238 resonance peaks broaden and flatten with increased fuel temperature, the area under the peak curve remains the same. WHY is there an increase in neutron absorption or capture as the fuel temperature increases? (1.0)

QUESTION 5.08 (2.00)

The ratio of Plutonium atoms to U 235 atoms increases as the core ages. EXPLAIN what effect the ratio increasing has on the following: (2.0)

- a. Delayed Neutron Fraction
- b. SUR
- c. Doppler defect

QUESTION 5.09 (1.50)

The heat output of the reactor can continue to cause the fuel to heatup following a reactor shutdown. WHAT is(are) the source(s) of this thermal power, and WHY does it NOT indicate on the nuclear instrumentation? (1.5)

QUESTION 5.10 (3.00)

The plant has been operating at 60% power for several days with all rods out. A single CEA drops into the core but does not cause a reactor trip.

- a. Explain HOW and WHY the dropped CEA will affect the MAXIMUM (peak) linear power in the core? (1.5)
- b. HOW and WHY will the maximum linear power in the core change over the next three hours if the CEA is not recovered? (1.5)

QUESTION 5.11 (1.00)

Which of the following statements BEST describes what happens to a fluid as it passes through a venturi? (1.0)

- a. Pressure remains constant, but the velocity increases as the diameter of the venturi decreases.
- b. Pressure increases and velocity decreases as the diameter of the venturi decreases.
- c. Pressure increases and velocity remains constant as the diameter of the venturi increases.
- d. Pressure increases, but the velocity decreases as the diameter of the venturi increases.

QUESTION 5.12 (2.00)

Indicate whether each of the following will INCREASE, DECREASE, or REMAIN UNCHANGED as the discharge valve of a running, motor operated, centrifugal pump is throttled (valve moved in the shut direction): (2.0)

- a. Pump motor amps
- b. Pump discharge flow
- c. Pump discharge pressure
- d. Actual NPSH available at the pump (Assume fluid temperature remains constant)

QUESTION 5.13 (2.00)

Would fuel center line temperature INCREASE, DECREASE, or REMAIN THE SAME in each of the following situations?

- a. Power decreases with constant Tave. (0.5)
- b. Tave increases with constant power. (0.5)
- c. Core age increases with constant power. (0.5)
- d. Pressurizer pressure increases with constant power. (0.5)

QUESTION 6.01 (1.50)

What conditions will cause a HPSI pump A/B unavailability alarm? (1.5)

QUESTION 6.02 (2.50)

- a. What inputs are required to generate a High Level Override (HLO) signal? (0.5)
- b. WHAT output does the HLO logic generate, and HOW does this affect the Main Regulating Valve, Bypass Regulating Valve, and Main Feed water pumps? (1.5)
- c. When does the HLO signal reset? (0.5)

QUESTION 6.03 (2.50)

- a. What provides the input signals to the Reactor Trip Override (RTO) logic? (0.5)
- b. When the RTO logic is actuated, what effects or limits are imposed on the Main Regulating Valve, Bypass Regulating Valve, and MFW pumps? (1.5)
- c. When does the RTO logic reset? (0.5)

QUESTION 6.04 (2.50)

- a. What provides the heat sink for the Component Cooling Water system during minimum heat load conditions? (0.5)
- b. As the heat load on the Component Cooling Water system increases, what other components/systems are used to remove this heat? Indicate the order of use as temperature increases. Numbers and setpoints are NOT required. (2.0)

QUESTION 6.05 (2.00)

- a. Briefly describe how each of the two (2) systems in the Hydrogen Control System is utilized to keep the concentration of hydrogen low following an accident. (1.0)
- b. What are the three (3) major sources of hydrogen following a LOCA?(1.0)

QUESTION 6.06 (2.00)

Match each of the following areas (a - d) with the type of automatic fire suppression system present in that area. (2.0)

AREA	SYSTEM
a. Turbine generator bearings	1. Halon
b. Reactor coolant pumps	2. wet pipe sprinkler
c. Fuel oil storage tanks (yard)	3. deluge sprinkler
d. Computer room	4. pre-action sprinkler
	5. foam water
	6. multi-cycle sprinkler

QUESTION 6.07 (2.50)

Sketch a typical safety related static uninterruptable power supply showing major components and normal and alternate power inputs. (2.5)

QUESTION 6.08 (2.00)

Each Reactor Coolant Pump (RCP) is provided with eight separate speed sensors. Briefly indicate what each of the eight sensors provide in the way of control, protection, or indication. Setpoints are NOT required. (2.0)

QUESTION 6.09 (2.50)

The reactor is operating at high power with all systems in their normal lineup. The pressurizer level channel selected for control fails HIGH. Describe the plant response until either conditions stabilize or a reactor trip occurs. Assume no operator action. Alarms and annunciators are not required. (2.5)

QUESTION 6.10 (2.00)

Briefly describe the design of the Reactor Vessel Level Indicating System (heated junction thermocouples) and how it detects a varying water level in the reactor vessel. (2.0)

QUESTION 6.11 (3.00)

For each of the situations below (a - f), indicate which power signal(s) (from 1 - 5) is(are) being used by COLSS as reactor power. Answers to a - f may require more than one response from 1 - 5. (3.0)

- | | |
|--|-------------------------------------|
| a. Reactor power is 10% | 1. Primary Calorimetric (BDELT) |
| b. Reactor power is 50% | 2. Secondary Calorimetric (BSCAL) |
| c. Reactor power is 50%,
BSCAL has failed | 3. Turbine Impulse Pressure (BTFSF) |
| d. Reactor power is 50%,
CBTFSP has failed | 4. Calibrated BDELT (CBDELT) |
| e. Reactor power is 100%,
BSCAL and BDELT have failed | 5. Calibrated BTFSF (CBTFSP) |
| f. Reactor power is 100%,
CBDELT and CBTFSP have failed | |

QUESTION 7.01 (1.00)

According to OP-902-000, how is subcooling margin to be determined when below 1000 psia in the RCS? (1.0)

QUESTION 7.02 (1.50)

Following a reactor trip, what two (2) conditions require that ALL reactor coolant pumps be stopped? (1.5)

QUESTION 7.03 (2.00)

List five (5) of the eight (8) emergency categories used to classify events covered by the emergency plan. (2.0)

QUESTION 7.04 (1.00)

During recovery from loss of RCS coolant, under what condition(s) may the RCS be operated solid? (1.0)

QUESTION 7.05 (3.00)

During casualty recovery, there are three sets of system conditions and one caution that must be satisfied prior to restarting any RCP if all of them were secured during the casualty. List the three sets of system conditions and the caution. (This DOES NOT relate to the RCP consecutive start/restart criteria.) (3.0)

QUESTION 7.06 (2.50)

Except for Steam Generator Level, list the indications that must be checked to verify natural circulation include numerical values where specified in the procedure. (2.5)

QUESTION 7.07 (2.50)

During plant startup from cold shutdown, as the evolutions are completed which move the plant up to the next operating mode, the operators are required to verify the plant conditions which assure that the plant is in the anticipated mode. List five (5) of the conditions that must be verified to assure that the plant is in mode 2. DO NOT include the required switchyard configuration. (2.5)

QUESTION 7.08 (1.50)

OP-010-001, General Plant Operations, directs that CEA withdrawal during power operation should be in small, frequent steps (less than 3 inches). What is the basis for this operational requirement? (1.5)

QUESTION 7.09 (2.00)

List the immediate actions for Inadvertent Safety Injection/Containment Isolation. (2.0)

QUESTION 7.10 (2.00)

- a. What two potential meteorological conditions should be expected when a Severe Thunderstorm Warning is issued? (1.0)
- b. What is the principle information source for each of the following?
 - 1. River stage and crest forecast. (0.5)
 - 2. Levee status and hydrologic gauge station information. (0.5)

QUESTION 7.11 (2.00)

What are the immediate actions taken by the control room operators and supervisors when the order to evacuate the control room is given with the plant at power? (2.0)

QUESTION 7.12 (1.00)

Potassium Iodide (KI) is administered to block the thyroid gland from absorbing radioactive isotopes of Iodine that may be released as a result of fuel failure. How long AFTER exposure to radioactive Iodine will the effectiveness of KI be; (1.0)

- a. reduced to one-half?
- b. of little or no benefit?

QUESTION 7.13 (2.00)

- a. Why are we concerned about "Quality Factors" with regard to radiation? (1.0)
- b. What are the "Quality Factors" for the various kinds of radiation that may be present at W3SES? (1.0)

QUESTION 7.14 (1.00)

What is the MAXIMUM dose you could expect to receive in a radiation area posted inside the controlled access in one hour? (1.0)

QUESTION 8.01 (1.50)

If it is essential to release a clearance, how is it done if neither the originating individual, his supervisor, nor his department head can be located? (1.5)

QUESTION 8.02 (2.00)

Give four (4) general cases when temporary alterations may be installed without a TAR. DO NOT include the specific provisions for each case. (2.0)

QUESTION 8.03 (1.00)

When may a TAR be initiated and approved AFTER a temporary alteration has already been installed? (1.0)

QUESTION 8.04 (1.00)

What type of controlled keys are NOT controlled by OP-100-008, Key Control?

QUESTION 8.05 (3.00)

Which of the following items are addressed by Technical Specifications. Answer YES if the item is and NO if the item is not addressed in the Technical Specifications. (3.0)

QUESTION 8.06 (3.00)

For each of the following items, indicate whether the condition is INSIDE or OUTSIDE the Technical Specification Limiting Condition for Operation. Compliance with an Action Statement is considered to be OUTSIDE the LCO.(3)

- a. An emergency diesel generator with local control selected to "manual".
- b. Primary containment pressure is 15.94 psia.
- c. Pressurizer pressure instrument with a small amount of reactor coolant leakage (10 cc/hr) and total unidentified leakage is <1gpm.
- d. Condensate storage pool level at 85%.
- e. One safety injection tank level at 87%.
- f. Cooling water to Containment Fan Cooler 1D is 640 gpm.

QUESTION 8.07 (2.00)

List four (4) parameters which must be manually calculated when COLSS is out of service.

QUESTION 8.08 (4.00)

Which of the follow conditions or events would result in an Emergency Action Level classification of "ALERT" or higher? Indicate yes or no for each one.

- a. Loss of all onsite DC power.
- b. Dose equivalent I-131 of the RCS is 350 uCi/ml, not due to spiking.
- c. Loss of both shutdown cooling trains with anticipation of recovering at least one train in <1 hour.
- d. Evacuation of the control room anticipated with control of shutdown systems established from local stations.
- e. RCS leakage greater than 44 gpm but less than 100 gpm.
- f. Area Radiation Monitor reading on the RM-11 console trending upward by a factor of 10E+3 with no explanation.
- g. Steam line fault with 12 gpm primary to secondary leakage.
- h. Site experiencing winds greater than 75 mph.

(0.5 EACH)

QUESTION 8.09 (1.50)

- a. Fill in the blank. In accordance with 10 CFR 55, "if a licensee has not been actively performing the functions of an operator or senior operator for a period of _____ months or longer, he shall, prior to resuming activities licensed pursuant to this part, demonstrate to the Commission that his knowledge and understanding of facility operation and administration are satisfactory." (0.5)
- b. Actions may be taken that depart from a license condition or technical specification under what conditions (if any)? (1.0)

QUESTION 8.10 (1.00)

*** EMPTY QUESTION ***

QUESTION 8.11 (3.00)

The Shift Supervisor is to request the advice of the STA during plant transients per OP-100-01, Duties and Responsibilities of Operators on Duty.

- a. What constitutes a REACTOR TRANSIENT? (1.5)
- b. What constitutes a SECONDARY SYSTEM TRANSIENT? (1.5)

QUESTION 8.12 (2.00)

- a. What is a CORE ALTERATION? (1.0)
- b. What personnel are required to be present during core alterations?(1.0)

NRC LICENSE EXAMINATION HANDOUT

EQUATIONS, CONSTANTS, AND CONVERSIONS

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

$$\dot{Q} = U A \Delta T$$

$$P = P_0 \cdot 10^{\text{SUR} \cdot (t)}$$

$$P = P_0 \cdot e^{t/T}$$

$$\text{SUR} = 26/T$$

$$T = 1^*/p + (\beta - p)/\bar{\lambda} p$$

$$T = 1/(p - \beta)$$

$$T = (\beta - p)/\bar{\lambda} p$$

$$p = (K_{\text{eff}} - 1)/K_{\text{eff}} = \Delta K_{\text{eff}}/K_{\text{eff}} \quad p = 1^*/TK_{\text{eff}} + \bar{\beta}_{\text{eff}}/(1 + \bar{\lambda} T)$$

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

$$\bar{\lambda} = 0.1 \text{ seconds}^{-1}$$

$$I = I_0 \cdot e^{-u x}$$

$$\text{CR} = S/(1 - K_{\text{eff}})$$

$$R/\text{hr} = 6 \cdot \text{CE}/d^2 \text{ feet}$$

Water Parameters

$$1 \text{ gallon} = 8.345 \text{ lb}_m = 3.87 \text{ liters}$$

$$1 \text{ ft}^3 = 7.48 \text{ gallons}$$

$$\text{Density @ STP} = 62.4 \text{ lb}_m/\text{ft}^3 = 1 \text{ gm/cm}^3$$

$$\text{Heat of vaporization} = 970 \text{ Btu/lb}_m$$

$$\text{Heat of fusion} = 144 \text{ Btu/lb}_m$$

$$1 \text{ atmosphere} = 14.7 \text{ psia} = 29.9 \text{ inches Hg.}$$

Miscellaneous Conversions

$$1 \text{ curie} = 3.7 \times 10^{10} \text{ disintegrations per second}$$

$$1 \text{ kilogram} = 2.21 \text{ lb}_m$$

$$1 \text{ horsepower} = 2.54 \times 10^3 \text{ Btu/hr}$$

$$1 \text{ mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

$$1 \text{ inch} = 2.54 \text{ centimeters}$$

$$\text{degrees F} = 9/5 \text{ degrees C} + 32$$

$$\text{degrees C} = 5/9 (\text{degrees F} - 32)$$

$$1 \text{ Btu} = 778 \text{ ft-lb}_f$$

DIETZGEN CORPORATION
MADE IN U. S. A.

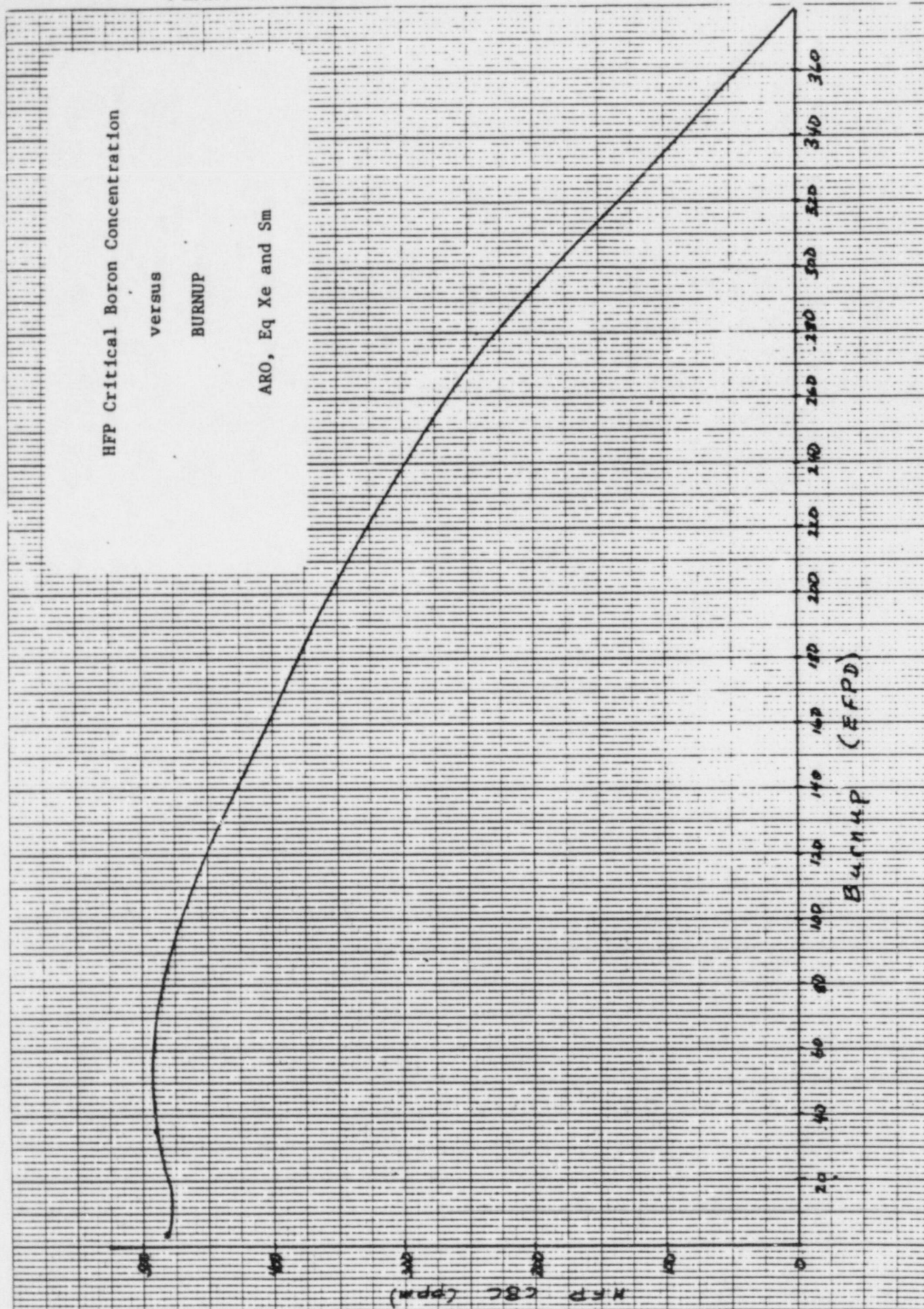
NO. 340-10', DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

HFP Critical Boron Concentration

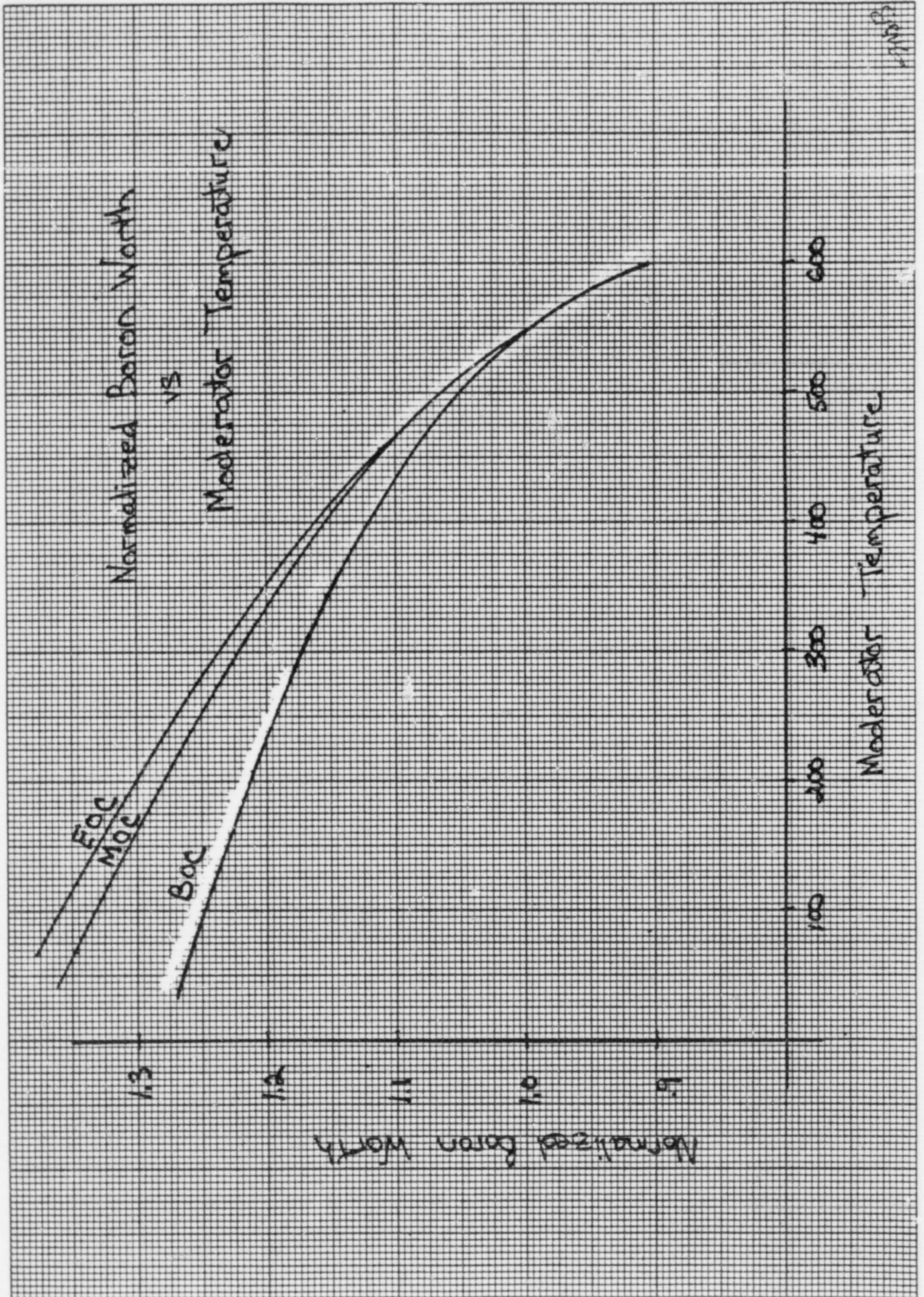
versus

BURNUP

ARO, Eq Xe and Sm



NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH
DIETZGEN CORPORATION
MADE IN U.S.A.



EOC

DIFFERENTIAL BORON WORTH
VS.
MODERATOR TEMPERATURE
EOC

DIFFERENTIAL BORON WORTH (% ΔK_e/100 PPM)

-2.0
-1.9
-1.8
-1.7
-1.6
-1.5
-1.4
-1.3
-1.2
-1.1
-1.0

0 100 200 300 400 500 600

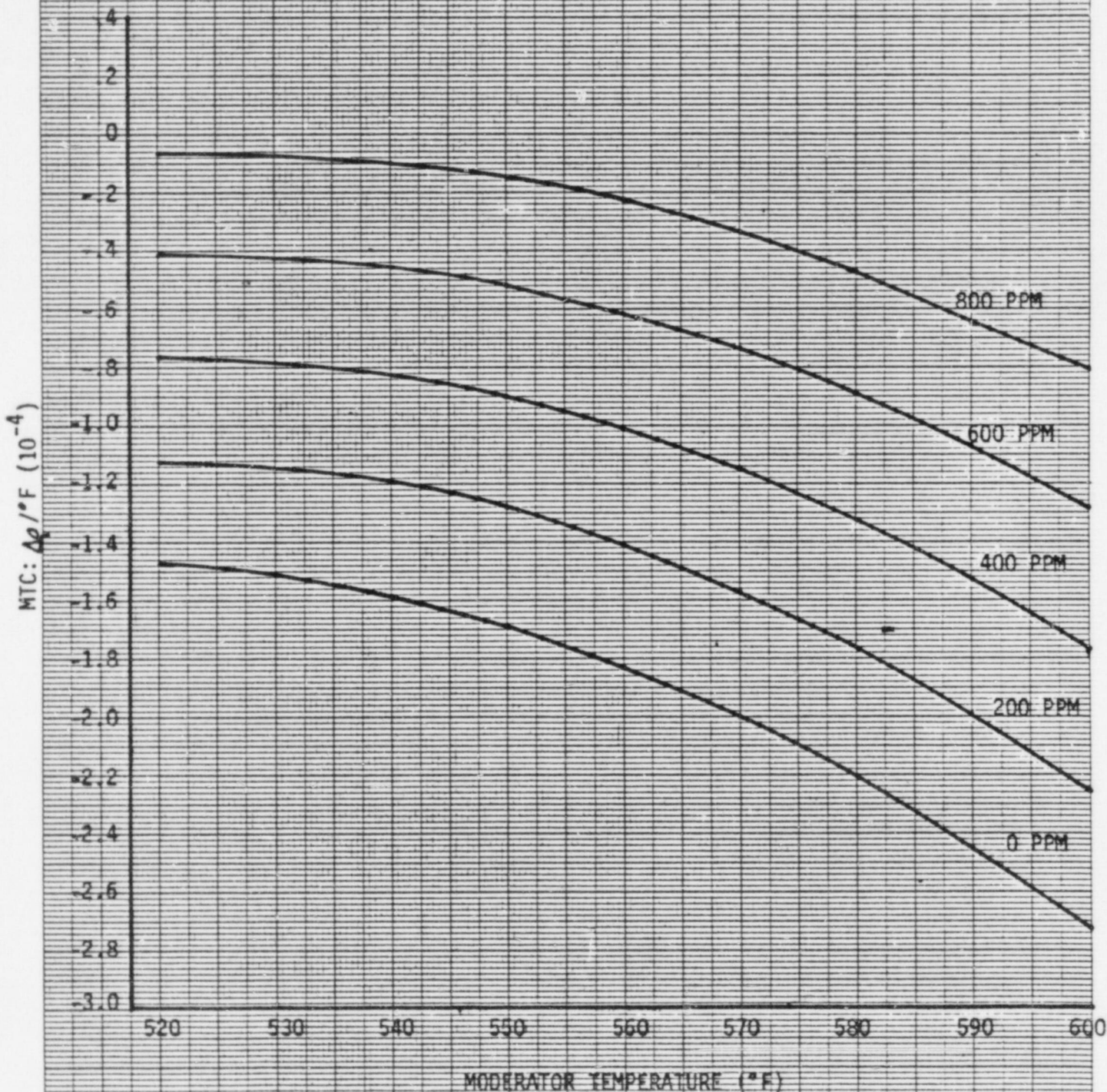
MODERATOR TEMPERATURE (°F)

1 PPM
500 PPM
900 PPM
1300 PPM
1700 PPM
2100 PPM

461510

K&E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KLEUPFEL & ESSER CO. MADE IN U.S.A.

EOC
MODERATOR TEMPERATURE COEFFICIENT
VS.
CORE AVERAGE MODERATOR TEMPERATURE



46 1510

K&E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 5.01 (1.00)

In mode 5 the plant is completely cooled down (below 200 deg. F) so that there is no need to have reserve shutdown margin to offset the positive reactivity addition resulting from a rapid cooldown accident while in modes 1-4. (1.0)

REFERENCE
CE SAFETY ANALYSIS

ANSWER 5.02 (2.00)

- a. If the ASI is positive, the power in the lower half of the core is greater than that in the upper half. (1.0)
- b. The upper half if the core is closer to DNB since it is at the lowest pressure and highest temperature region of the core. Maintaining a positive ASI helps ensure that DNB does not occur anywhere in the core. (Accept Xenon oscillation control.) (1.0)

REFERENCE
W3SES TS DEFINITIONS AND BASES

ANSWER 5.03 (3.00)

(ANY 5 AT 0.4 FOR FACTOR AND 0.2 FOR DIRECTION EACH)

1. Fuel densification - increase
2. Fuel pellet swelling - decrease
3. Clad creep - decrease
4. Clad corrosion - increase
5. Crud buildup - increase
6. Nature of the gas in the gap - increase
7. Concentration of the gas in the gap - decrease.
8. Fuel pellet cracking - decrease

REFERENCE
BASIC CORE HTTF

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 5.04 (3.00)

The net effect will be to decrease temperature. The final values of pressure and power will be the same as in the beginning.

From figure 1.4.5.1 (or 1.4.5.2) the boron worth is 79.3 ppm/%d rho
The reactivity inserted = $-10\text{ppm}/79.3 \text{ ppm}/\%d \text{ rho} = 0.126 \%d \text{ rho}$

From figure 1.2.5.1 the MTC = $-1.7 \text{ E-4 } d \text{ rho}/deg.F = -0.017 \%d \text{ rho}/deg.F$

The change in temperature = $-0.126/0.017 = -7.4 \text{ deg.F}$

Tavg goes from 582 deg.F to 574.6 deg.F

From figure 1.3.1 the initial boron concentration was about 250 PPM so that the final concentration is about 260 ppm (accept 260 to 270).

(0.4 EACH for final temperature, pressure, power, and boron concentration;
0.35 EACH for values (4) taken from figures or calculated.)

Note: Expanded ranges were used for grading because figure 1.4.5.1 was inadvertently left out of the exam package.

REFERENCE

W3SES TDB, STD REACTOR THEORY

ANSWER 5.05 (1.50)

- a. Increase as Th goes up due to boiling in the core.
- b. Increase due to boiling in the core (and loss of heat removal).
- c. Decrease due to loss of heat transfer through the steam generators.

(0.2 for change and 0.3 for explanation)

REFERENCE

BASIC HTTF

ANSWER 5.06 (2.00)

Concentration increases (0.5) and reactivity increases (0.5) due to boron reduction over core life reducing competition for neutrons (0.5) and flux increasing as a function of core age (0.5). (Increased Iodine production from Pu.)

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

REFERENCE

Basic Reactor Theory

ANSWER 5.07 (1.00)

The neutrons that were off-resonance are now being absorbed in increasing numbers due to absorption cross section increasing in the previously off-resonance range (1.0) (and fuel pellet self shielding has decreased).

REFERENCE

Standard Reactor Theory

ANSWER 5.08 (2.00)

- a. The delayed neutron fraction decreases (0.333) due to Plutonium producing fewer delayed neutrons than U 235 (0.333).
- b. SUR would increase (0.333) for a given reactivity change because of a smaller delayed neutron input (0.333).
- c. The doppler defect would increase (0.333) because of the production of Pu 240 (0.333), a high cross section resonant absorber.

REFERENCE

Standard Reactor Theory

ANSWER 5.09 (1.50)

This thermal power is mainly from the decay of fission products (0.5). It does not indicate on the nuclear instrumentation because it consists mainly of alpha, beta, and gamma radiation from the decay of the fission products, which are not detected on the nuclear instrumentation (1.0).

REFERENCE

Standard Reactor Theory

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 5.10 (3.00)

- a. The core maximum linear power will increase (0.5). Total core power does not change. The linear power near the dropped CEA will decrease (0.5), but the rest of the core will be producing a higher linear power (0.5).
- b. Xenon will build in near the inserted CEA due to burnout decreasing (0.5). This will further suppress power generation in this area (0.5), and cause the maximum linear power to increase elsewhere in the core (0.5).

REFERENCE

Basic Reactor Theory

ANSWER 5.11 (1.00)

d (1.0)

REFERENCE

Standard Fluid Flow Principles

ANSWER 5.12 (2.00)

- a. decrease (0.5)
- b. decrease (0.5)
- c. increase (0.5)
- d. increase (0.5)

REFERENCE

Standard Fluid Flow and Pump Principles

ANSWER 5.13 (2.00)

- a. Decrease (0.5)
- b. Increase (0.5)
- c. Decrease (0.5)
- d. No change (0.5). Accept increase if the assumption is stated that increasing pressure decreases nucleate boiling.

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

REFERENCE

PWR Thermal Sciences FND-121, Lesson d-6, pg 15-17

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 6.01 (1.50)

1. Pump A/B selector switch in A or B, SIAS present and the bkr not closed after one second (0.4).
2. If any valve lineup abnormalities exist between the suction and discharge valves (0.3) (SI-202A & B, SI-212A & B).
3. If the pump valves are aligned to the B header and power is lost to the A safeguards room chiller unit (0.4).
4. If A/B pump selector switch selected to A with A/B bus powered by B, or vice versa. (0.4)

REFERENCE

SI System Description, pg 26

ANSWER 6.02 (2.50)

- a. Selected S/G level must be >89% for the affected S/G (0.5).
- b. Provides a zero flow demand signal (0.5). Both regulating valves shut (0.5). MFW pump speed remains the same (0.5).
- c. 87% decreasing in the affected S/G (0.5).

REFERENCE

Feedwater Control System, pg 26

ANSWER 6.03 (2.50)

- a. CEDMCS undervoltage relay status signals (0.5)
- b. FW pump speed is held at minimum (3900rpm) (0.5). The Bypass (startup) Regulating Valve is held at its minimum (20 - 24%) open position (5% flow demand) (0.5) and the Main Regulating Valve is shut (0.5).
- c. Flow demand <5% (0.5)

REFERENCE

FW Control System, pg 27-29

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 6.04 (2.50)

- a. Dry cooling towers (0.5)
- b. As the CC temperature increases, the dry cooling tower fans sequence on (0.5). As temperature continues to increase, the ACC pumps start (0.5), providing cooling to the CCW HX (0.5). As ACCW temperature increases, the wet tower fans sequence on (0.5) to control the wet cooling tower basin temperature.

REFERENCE

CCW System Description, pg 6-8

ANSWER 6.05 (2.00)

- a. Hydrogen recombiners (0.2) cause the free hydrogen to recombine with oxygen to form water (0.3). The Containment Atmosphere Release System (0.2) is used to purge the containment atmosphere to the containment annulus (0.3).
- b.
 - 1. Radiolysis of water (0.333)
 - 2. Zr-water reaction (0.333)
 - 3. Corrosion of metals in containment by the caustic spray (0.333).

REFERENCE

Hydrogen Control System Description, pg 2, 4, 12, 23

ANSWER 6.06 (2.00)

- a. 4
 - b. 6
 - c. 5
 - d. 1
- (0.5 each)

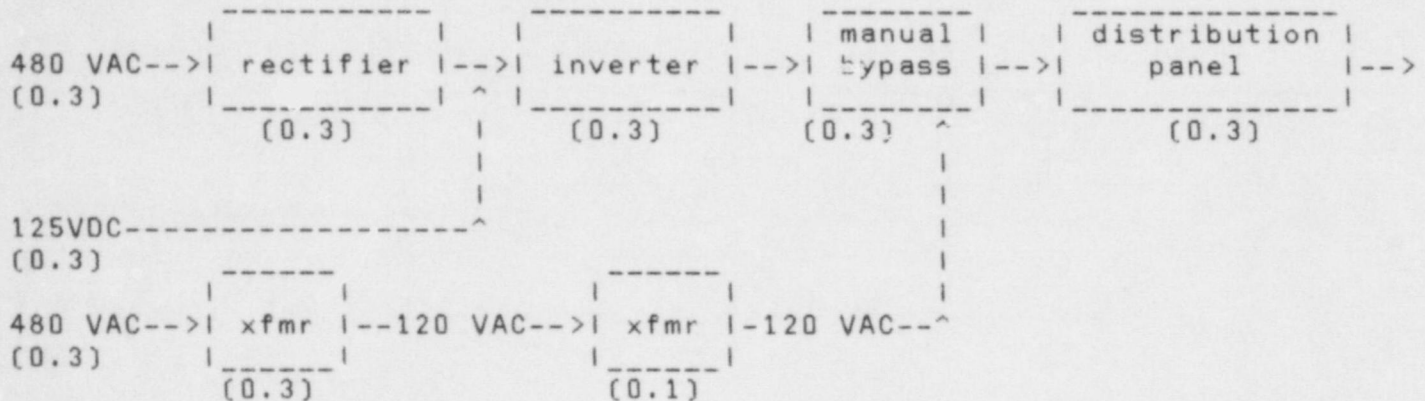
REFERENCE

Fire Protection System Description, pg 65-66

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 6.07 (2.50)



REFERENCE

Inverters and Distribution System Description, fig. 59-2

ANSWER 6.08 (2.00)

1. 4 sensors (0.125) are CPC inputs (0.25) to compute RCS flow (0.25)
2. 2 sensors (0.125) are COLSS inputs (0.25) to compute RCS flow (0.25)
3. 1 sensor (0.125) is for start/stop signals to the oil lift pumps (0.25)
4. 1 sensor (0.125) provides zero speed indication (0.25)

REFERENCE

RCS System Description, pg 61-62

ANSWER 6.09 (2.50)

(Indicated pressurizer level indicates high.) The letdown valves open to max letdown (128 gpm) (0.5). The pressurizer heaters energize due to the high level error signal (0.5). Actual pressurizer level is decreasing (0.5) and primary pressure is decreasing with level (0.5). A reactor trip occurs due to low pressure (0.5). CAF about heater response when 28% level is reached on the operable level indicator.

REFERENCE

23-24

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 6.10 (2.00)

Two thermocouples are placed in the same general location (0.5). A heater is located adjacent to one of the thermocouples (0.5). In a vapor/steam environment, the thermocouple located nearest the heater will indicate a higher temperature (0.5). When the detector is covered with water, the water carries the heater's heat away, and very little, if any, temperature difference exists between the two thermocouples (0.5).

REFERENCE

Reactor Vessel and Internals System Description, pg 23

ANSWER 6.11 (3.00)

- a. larger of 1 and 3 (0.5)
- b. larger of 4 and 5 (0.5)
- c. larger of 1 and 3 (0.5)
- d. 4 (0.5)
- e. 3 (0.5)
- f. 2 (0.5)

REFERENCE

COLSS System Description, pg 20-22, Fig. 14 and 14A

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 7.01 (1.00)

Subtract T-hot from PRESSURIZER TEMPERATURE WATER (TI 101) (1.0)

REFERENCE
W3SES OP-902-000

ANSWER 7.02 (1.50)

Pressurizer pressure $\leq$ 1621 psia (following an SIAS)
Loss of CCW to RCPs for $\geq$ 3 min.
Receipt of CSAS
(ANY 2 at 0.75 ea)

REFERENCE
W3SES OP-902-002

ANSWER 7.03 (2.00)

(ANY 5 AT 0.4 EACH)
1. Uncontrolled release of radioactivity
2. Loss of RCS inventory
3. DNB/Degraded core sequence
4. Loss of safety functions (loss of fission product barriers)
5. Hazards to station operations
6. Natural phenomena
7. Security compromise
8. Miscellaneous

REFERENCE
W3SES EP-1-001

ANSWER 7.04 (1.00)

When subcooled margin $<$ 28 deg.F (or near saturation) (1.0)

REFERENCE
W3SES OP-902-002

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 7.05 (3.00)

CAUTION - DO NOT run RCPs if CCW has been lost for $\Rightarrow$ 10 min. 0.375
Restart if;

1. Pressurizer level is BOTH
a. $\Rightarrow$ 28% 0.375
b. Constant OR rising 0.375
2. RCS Subcooling Margin $\Rightarrow$ 28 deg F 0.375
3. BOTH Steam Generators are satisfying either;
a. Steam Generator level wide range is BOTH
1) $\Rightarrow$ 50% 0.375
2) Constant OR rising 0.375
OR
b. Level is being restored by either;
1) $\Rightarrow 0.378 \times 10^6$ lbm/hr main feedwater flow OR 0.375
2) $\Rightarrow$ 150 gpm EFW flow 0.375

REFERENCE
W3SES OP-902-002

ANSWER 7.06 (2.50)

1. Loop dT < 64 deg F
2. Cold leg temperature constant OR dropping
3. Hot leg temperature constant OR dropping
4. Core temperature AND hot leg temperature dT < 10 deg F
5. Steam Generator pressure $\sim$ saturation pressure for existing Tc.

(0.5 each)

REFERENCE
W3SES OP-902-003

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 7.07 (2.50)

(any 5 at 0.5 each)

1. The steam bypass control system is operating to maintain RCS Tavg at the no load value.
2. Pressurizer pressure and level are being maintained at 2250 +/- 15 psia and ~ 33%, respectively.
3. Steam generator water level is being maintained 50 - 70% on CP-1, with feedwater control in "MANUAL".
4. The main turbine is on the turning gear and not latched.
5. The station electrical system is ready for normal power operation with electrical buses being fed from the startup transformers.
6. The plant is stable at <=5% full power.
7. Control element assemblies are positioned above the transient insertion limit.

REFERENCE

W3SES OP-010-001

ANSWER 7.08 (1.50)

This will reduce the likelihood of fuel failure (0.5) due to large local power densities (0.5) in the vicinity of the CEA finger tips. (0.5)

REFERENCE

CE GENERIC CHARACTERISTICS

ANSWER 7.09 (2.00)

- | | |
|---|---------|
| 1. Pressurizer level is BOTH; | 0.125 |
| a. =>28% | 0.25 |
| b. Constant or rising | 0.25 |
| 2. RCS subcooling margin =>28 deg F | 0.25 |
| 3. BOTH steam generators are satisfying either; | 0.125 |
| a. Steam generator level wide range is BOTH | |
| 1) =>50% | 0.25 |
| 2) constant or rising | 0.25 |
| OR | |
| b. Level is being restored by either; | |
| 1) main feedwater flow | OR 0.25 |
| 2) emergency feedwater flow | 0.25 |

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

REFERENCE

W3SES OP-901-042

ANSWER 7.10 (2.00)

- a. High Wind (>58 mph) (0.5)
Hail (>.75 inch diameter) (0.5)
- b. 1. National Weather Service (0.5)
2. U.S. Army Corps of Engineers (0.5)

REFERENCE

W3SES OP-901-045

ANSWER 7.11 (2.00)

(0.25 each)

The primary operator will;

- 1. trip the reactor and verify all CEAs are inserted.
- 2. verify spray valve selector switch in the BOTH position.
- 3. proceed to LCP -43.

The secondary operator will;

- 1. verify the turbine and generator are tripped.
- 2. reset the moisture separator reheater controls.
- 3. proceed to RAB +35 relay room.

The shift supervisor will proceed to LCP -43.

The control room supervisor will proceed to RAB +43 relay room.

REFERENCE

W3SES OP-901-004

ANSWER 7.12 (1.00)

- a. 3-4 hours (0.5)
- b. 10-12 hours (0.5)

REFERENCE

W3SES EP-2-003

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 7.13 (2.00)

- a. Quality Factor - Different types of radiation have different ionizing ability and therefore different potential for causing biological damage. (1.0)
- b. Gamma or X rays - 1
Beta - 1
Alpha (internal) - 20
Thermal neutrons - 3
Fast neutrons - 10
(0.2 each)

REFERENCE

General Radcon

ANSWER 7.14 (1.00)

100 mrem or just slightly less (based on next posting level beginning at 100 mR/hr).

REFERENCE

General Radcon

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 8.01 (1.50)

The SS/CRS and appropriate department representatives (0.5) must make the necessary inspections (0.4) and receive oral authorization from the Plant Manager-Nuclear (0.3) or an Assistant Plant Manager-Nuclear before the tags are removed and the equipment operated (0.3). (The receipt of such oral authorization shall be documented in the log.)

REFERENCE

W3SES UNT-5-003

ANSWER 8.02 (2.00)

1. The temporary alteration is positively identified (and controlled) in an approved procedure.
2. The temporary alteration is performed for troubleshooting with an approved CIWA.
3. The temporary alteration is installed in components/systems removed from service with an approved CIWA.
4. Disabling annunciators by removing cards while complying with the ANNUNCIATOR AND ALARM STATUS CONTROL procedure.

(0.5 each)

REFERENCE

W3SES UNT-5-004

ANSWER 8.03 (1.00)

If a temporary alteration is installed as a part of an authorized controlling document (test procedure, CIWA, or other) and must remain installed upon completion of the activity controlled by the document, a TAR must be initiated and approved. (1.0)

REFERENCE

W3SES UNT-5-004

ANSWER 8.04 (1.00)

Area access keys (HP/security controlled room/area keys) (1.0)

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

REFERENCE

W3SES OP-100-008

ANSWER 8.05 (3.00)

a. yes	f. yes
b. no	g. no
c. no	h. yes
d. yes	i. yes
e. yes	j. yes

(0.3 EACH)

REFERENCE

W3SES T.S.

ANSWER 8.06 (3.00)

a. inside	3.8
b. outside	3.6.1.4
c. inside	3.4.5
d. inside	3.7.1
e. outside	3.5.1

(0.6 EACH)

REFERENCE

W3SES TS AS INDICATED

ANSWER 8.07 (2.00)

(ANY 4 AT 0.5 EACH)

1. DNBR margin verification (2 hr)
2. Axial shape index, ASI (12 hr)
3. Local power density, LPD (2 hr)
4. Azimuthal power tilt (12 hr)
5. RCS total flow (12 hr)

REFERENCE

W3SES OP-901-011

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

ANSWER 8.08 (4.00)

ALL OF THE ABOVE ARE ALERT OR HIGHER.
(0.5 ea)

REFERENCE

W3SES EP-1-001, ATTACHMENT 7

ANSWER 8.09 (1.50)

- a. Four (0.5)
- b. When the action is immediately needed to protect the public health and safety (0.75), and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent (0.25).

REFERENCE

10 CFR 55.31
10 CFR 50.54(x)

ANSWER 8.10 (1.00)

- a. Modes 1 - 4 (0.5)
- b. 10 (0.5)

REFERENCE

Technical Specifications, Table 6.2-1
UNT-7-011, Rev 1, pg 3

ANSWER 8.11 (3.00)

- a.
 - 1. power change >10% full power in <1 minute (0.5)
 - 2. Any unplanned reactor trip (0.5)
 - 3. Heatup or cooldown >100 deg F in one hour (0.5)
- b.
 - 1. power change >100 MWe in <1 minute
 - 2. any unplanned turbine trip
 - 3. any unplanned FW pump trip
 - 4. any unplanned generator trip
(any three at 0.5 ea)

ANSWERS -- WATERFORD 3

-86/08/19-MCCRORY, S.

REFERENCE

OP-100-01, Duties and Responsibilities of Operators on Duty, Rev 3, pg 10

UNT-7-011, Duties and Responsibilities of STA, Rev 1, pg 3

ANSWER 8.12 (2.00)

- a. Movement or manipulation of any component (0.25) within the reactor pressure vessel (0.25) with the reactor vessel head removed (0.25) and fuel in the vessel (0.25).
- b. All core alterations shall be performed or observed by a licensed RO (0.5) or SRO and supervised by either a SRO or SRO Limited to Fuel Handling (0.5).

REFERENCE

Technical Specification Definition 1.9

Technical Specification 6.2.2.d

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: WATERFORD 3
REACTOR TYPE: PWR-CE
DATE ADMINISTERED: 86/08/19
EXAMINER: GRAVES, D.
CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

CATEGORY	% OF	CANDIDATE'S	% OF	
VALUE	TOTAL	SCORE	VALUE	CATEGORY
25.00	25.00	-----	-----	1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.00	-----	-----	2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
25.00	25.00	-----	-----	3. INSTRUMENTS AND CONTROLS
25.00	25.00	-----	-----	4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
100.00		-----		Totals
		Final Grade		

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

Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.
2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.
3. Use black ink or dark pencil only to facilitate legible reproductions.
4. Print your name in the blank provided on the cover sheet of the examination.
5. Fill in the date on the cover sheet of the examination (if necessary).
6. Use only the paper provided for answers.
7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.
8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.
9. Number each answer as to category and number, for example, 1.4, 6.3.
10. Skip at least three lines between each answer.
11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.
12. Use abbreviations only if they are commonly used in facility literature.
13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.
14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.
15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.
16. If parts of the examination are not clear as to intent, ask questions of the examiner only.
17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

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

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

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

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

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

QUESTION 1.01 (2.00)

Describe HOW and WHY 100% equilibrium Xenon REACTIVITY and CONCENTRATION change, if at all, as a function of core age. (2.0)

QUESTION 1.02 (1.00)

Although the U 238 resonance peaks broaden and flatten with increased fuel temperature, the area under the peak curve remains the same. WHY is there an increase in neutron absorption or capture as the fuel temperature increases? (1.0)

QUESTION 1.03 (2.00)

The ratio of Plutonium atoms to U 235 atoms increases as the core ages. EXPLAIN what effect the ratio increasing has on the following: (2.0)

- a. Delayed Neutron Fraction
- b. SUR
- c. Doppler defect

QUESTION 1.04 (3.00)

The relative worth of a CEA is dependent on the neutron flux reaching it. LIST and briefly EXPLAIN four (4) factors or conditions which affect the flux reaching a particular CEA. (3.0)

QUESTION 1.05 (1.50)

The heat output of the reactor can continue to cause the fuel to heatup following a reactor shutdown. WHAT is(are) the source(s) of this thermal power, and WHY does it NOT indicate on the nuclear instrumentation? (1.5)

QUESTION 1.06 (3.00)

The plant has been operating at 60% power for several days with all rods out. A single CEA drops into the core but does not cause a reactor trip.

- a. Explain HOW and WHY the dropped CEA will affect the MAXIMUM (peak) linear power in the core. (1.5)
- b. HOW and WHY will the maximum linear power in the core change over the next three hours if the CEA is not recovered? (1.5)

QUESTION 1.07 (2.50)

Using the curves provided, calculate the amount of boron change required to stay on programmed values as power is increased from the initial conditions below to 75%. Include initial and final Tave's. (2.5)

Initial Conditions: Reactor power 50%
Middle of Cycle, All rods out
Boron concentration 600 ppm
Tave = Tref for 50% power

QUESTION 1.08 (.50)

Which of the following statements BEST describes what happens to a fluid as it passes through a venturi? (0.5)

- a. Pressure remains constant, but the velocity increases as the diameter of the venturi decreases.
- b. Pressure increases and velocity decreases as the diameter of the venturi decreases.
- c. Pressure increases and velocity remains constant as the diameter of the venturi increases.
- d. Pressure increases, but the velocity decreases as the diameter of the venturi increases.

QUESTION 1.09 (2.00)

Indicate whether each of the following will INCREASE, DECREASE, or REMAIN UNCHANGED as the discharge valve of a running, motor operated, centrifugal pump is throttled (valve moved in the shut direction): (2.0)

- a. Pump motor amps
- b. Pump discharge flow
- c. Pump discharge pressure
- d. Actual NPSH available at the pump (Assume fluid temperature remains constant)

QUESTION 1.10 (2.50)

- a. Where in the reactor core is nucleate boiling most likely to begin? Why does it start there rather than elsewhere? (1.5)
- b. What is the impact of going to nucleate boiling from the non boiling condition? (1.0)

QUESTION 1.11 (1.00)

Natural circulation flow rate is a function of four major factors. List the four factors. (1.0)

QUESTION 1.12 (2.00)

Would fuel center line temperature INCREASE, DECREASE, or REMAIN THE SAME in each of the following situations?

- a. Power decreases with constant Tave. (0.5)
- b. Tave increases with constant power. (0.5)
- c. Core age increases with constant power. (0.5)
- d. Pressurizer pressure increases with constant power. (0.5)

QUESTION 1.13 (2.00)

Indicate whether each of the following will INCREASE, DECREASE, or NOT AFFECT the Departure from Nucleate Boiling Ratio (DNBR). Assume all other parameters remain constant. (2.0)

- a. Primary coolant temperature decreases
- b. Primary coolant pressure decreases
- c. Primary coolant flow decreases
- d. Reactor power decreases

Power Defect

vs

Power Level

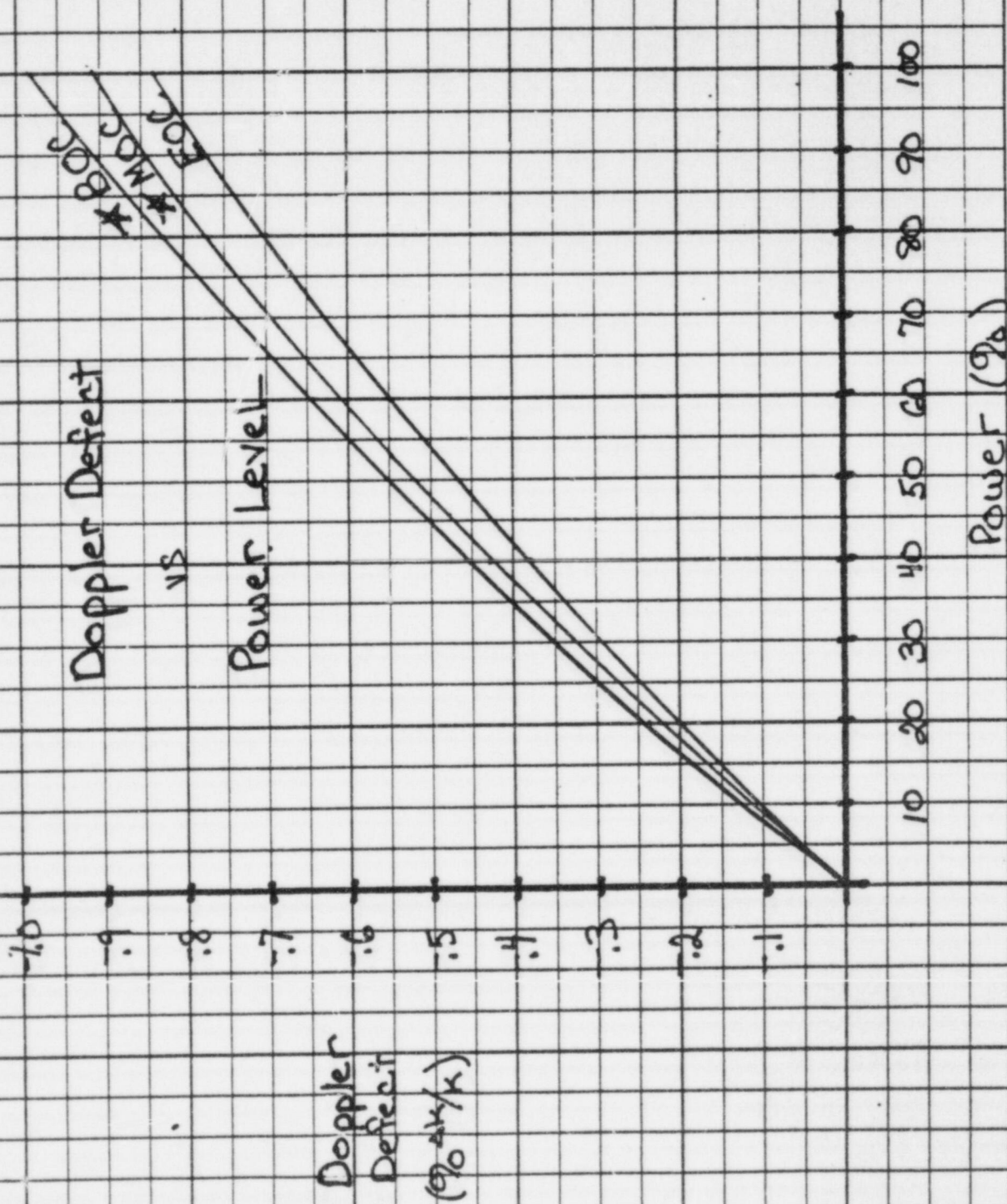
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2

Power Defect
(% ΔK)

100
Mid

10 20 30 40 50 60 70 80 90 100

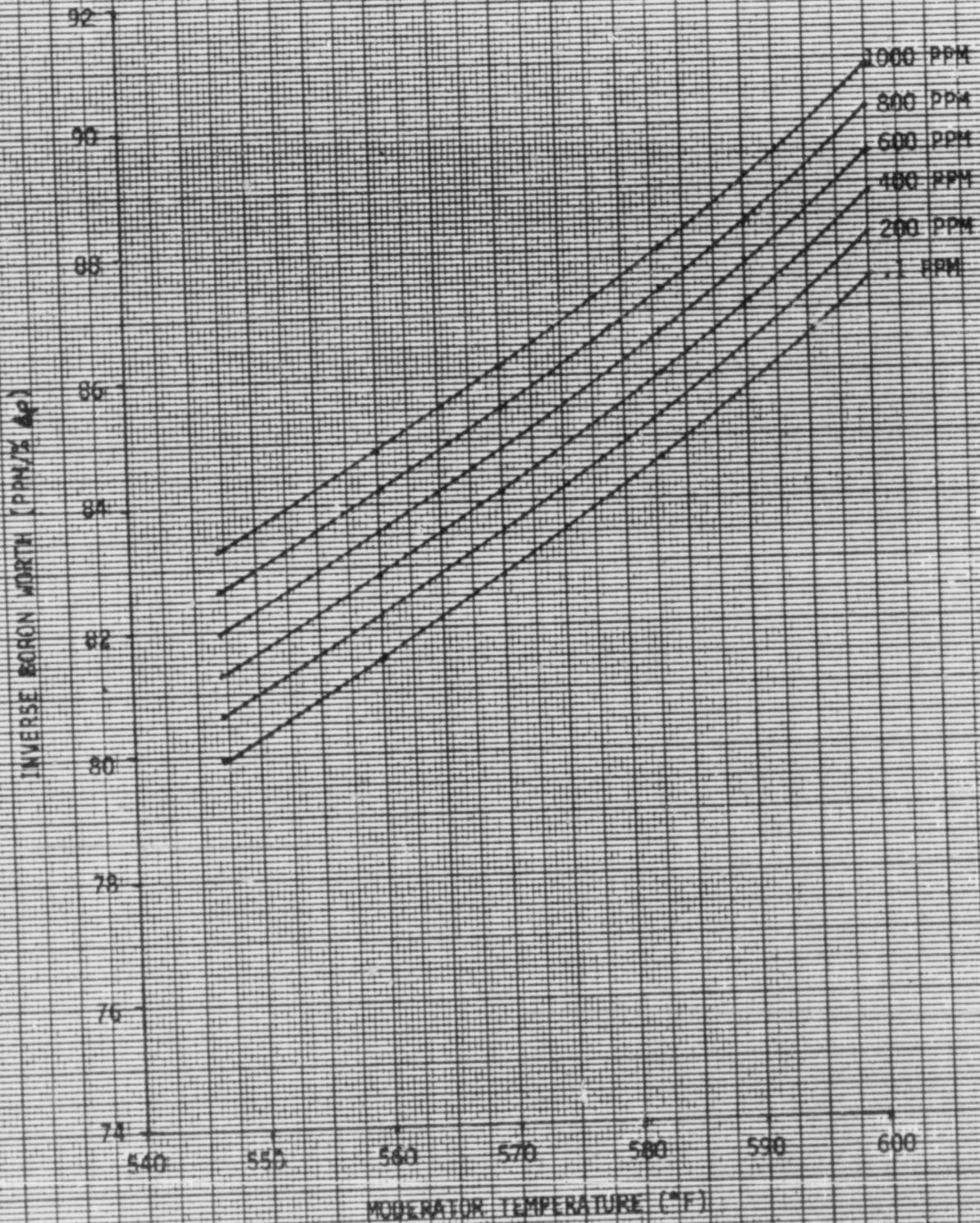
Power (%)



* NOTE: Doppler Defect may not be linear between BOC & MOC

WJB

MOC
Inverse Differential Boron Worth
vs.
CORE-AVERAGE MODERATOR TEMPERATURE



145

461510

K·E 10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

MOC

DIFFERENTIAL BORON WORTH
vs.
MODERATOR TEMPERATURE
MOC

DIFFERENTIAL BORON WORTH ($\Delta k/k$ / 100 PPM)

-2.0
-1.9
-1.8
-1.7
-1.6
-1.5
-1.4
-1.3
-1.2
-1.1
-1.0

0 100 200 300 400 500 600

MODERATOR TEMPERATURE (°F)

1 PPM
500 RPM
900 RPM
1300 RPM
1700 RPM
2100 RPM

461510

K-E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

RCS Temperature Control Bands vs Power

T_{REF} Program

RCS Temperature ($^{\circ}F$)

60
59
58
57
56
55
54

10 20 30 40 50 60 70 80 90 100

Power (%)

T_{HST}

T_{MID}

T_{COOL}

610

580

553

QUESTION 2.01 (3.00)

- a. While in the "holding" mode of operation, which coil(s) of a CEDM is(are) energized? (0.5)
- b. How does the system respond to a decrease in "holding" current? Include successful and unsuccessful response paths. (2.5)

QUESTION 2.02 (3.50)

- a. What are the normal and emergency backup sources of water for the Emergency Feedwater System (EFW)? (1.0)
- b. Is the changeover from the normal to the backup source accomplished manually or automatically? (0.5)
- c. The EFW pump turbine is equipped with redundant overspeed trips. State whether the overspeed trips automatically reset or must be manually reset. (1.0)
- d. What is the motive force for the EFW pump turbine steam line shutoff valves (MS 401 A & B)? (0.5)
- e. How do the above valves fail on loss of operating power? (0.5)

QUESTION 2.03 (2.00)

What are two (2) ways the operation of the containment spray system limits offsite radiation during accident conditions? (2.0)

QUESTION 2.04 (2.50)

- a. What provides the heat sink for the Component Cooling Water system during minimum heat load conditions? (0.5)
- b. As the heat load on the Component Cooling Water system increases, what other components/systems are used to remove this heat? Indicate the order of use as temperature increases. Numbers and setpoints are NOT required. (2.0)

QUESTION 2.05 (2.50)

- a. Briefly describe how each of the two (2) systems in the Hydrogen Control System is utilized to keep the concentration of hydrogen low following an accident. (1.0)
- b. What are the three (3) major sources of hydrogen following a LOCA? (1.5)

QUESTION 2.06 (2.00)

Match each of the following areas (a - d) with the type of automatic fire suppression system present in that area. (2.0)

AREA	SYSTEM
a. Turbine generator bearings	1. Halon
b. Reactor coolant pumps	2. wet pipe sprinkler
c. Fuel oil storage tanks (yard)	3. deluge sprinkler
d. Computer room	4. pre-action sprinkler
	5. foam water
	6. multi-cycle sprinkler

QUESTION 2.07 (2.50)

- a. Power is lost to CVE-401 (Controlled Bleedoff Containment Isolation Valve outside containment). How is controlled bleedoff flow maintained, if at all? (1.0)
- b. What function(s) does the controlled bleedoff provide? (1.0)
- c. What provides cooling for the controlled bleedoff? (0.5)

QUESTION 2.08 (1.00)

How is the possibility of cross-connecting the electrical safeguards buses through the HPSI A/B pump breakers eliminated? (1.0)

QUESTION 2.09 (2.00)

Each HPSI header contains a motor-operated orifice bypass valve and its associated flow orifice.

- a. During the injection mode following a SIAS, what is the status or position of the orifice bypass valves? (0.5)
- b. Indicate whether the following valve operation sequence is proper or not. If proper, state why this sequence is desired. If improper, state the potential undesirable consequence. (1.0)

When shifting to hot leg injection, an operator opens the hot leg injection valves, then shuts the orifice bypass valves.

- c. Once hot leg injection is established, how is the flow divided (per centage-wise) between hot and cold leg injection paths? (0.5)

QUESTION 2.10 (1.50)

- a. What are the two (2) automatic trips still functional for the Emergency Diesel Generators following an automatic start? (1.0)
- b. How is the engine shutdown by the operator following an emergency mode start? (0.5)

QUESTION 2.11 (2.50)

Sketch a typical safety related static uninterruptible power supply showing major components and normal and alternate power inputs. (2.5)

QUESTION 3.01 (2.00)

Each Reactor Coolant Pump (RCP) is provided with eight separate speed sensors. Briefly indicate what each of the eight sensors provide in the way of control, protection, or indication. Setpoints are NOT required.

(2.0)

QUESTION 3.02 (3.00)

The reactor is operating at high power with all systems in their normal lineup. The pressurizer level channel selected for control fails HIGH. Describe the plant response until either conditions stabilize or a reactor trip occurs. Assume no operator action. Alarms and annunciators are not required.

(3.0)

QUESTION 3.03 (2.00)

Briefly DESCRIBE THE DESIGN of the Reactor Vessel Level Indicating System (heated junction thermocouples) and HOW it detects a varying water level in the reactor vessel.

(2.0)

QUESTION 3.04 (2.00)

- a. How does the operator stop a HPSI pump if a SIAS has been received and is still present? (0.5)
- b. Once the above has been accomplished, what must the operator be aware of regarding subsequent operation of that pump? (1.0)
- c. What does the amber light at the pump control indicate to the operator? (0.5)

QUESTION 3.05 (2.50)

A transient has caused RCS pressure to decrease to the point where a SIAS is received.

- a. If RCS pressure decreases no lower than 100 psig below the SIAS setpoint, what will be the status/condition of the LPSI pumps, including flow paths, if applicable? (0.5)
- b. An inadvertent RAS is received at this time. How does the LPSI system respond? (1.0)
- c. How is the RAS actuation overridden in the LPSI system? (0.5)
- d. How is this override feature removed once it has been actuated? (0.5)

QUESTION 3.06 (3.00)

Describe the sequence of operation of the Main Feedwater (MFW) pump speed, Main Regulating Valve (MRV), and Bypass Regulating Valve (BRV) using the programs generated by the Feedwater Control System from 0% to 100% and back to 0%. Include the approximate flow demand values where the various components actuate or control. Assume initially that a MFW pump is running at minimum speed and the MRV and the BRV are shut. (3.0)

QUESTION 3.07 (3.00)

For each of the situations below (a - f), indicate which power signal(s) (from 1 - 5) is(are) being used by COLSS as reactor power. Answers to a - f may require more than one response from 1 - 5. (3.0)

- | | |
|--|-------------------------------------|
| a. Reactor power is 10% | 1. Primary Calorimetric (BDELT) |
| b. Reactor power is 50% | 2. Secondary Calorimetric (BSCAL) |
| c. Reactor power is 50%,
BSCAL has failed | 3. Turbine Impulse Pressure (BTFSP) |
| d. Reactor power is 50%,
CBTFSP has failed | 4. Calibrated BDELT (CBDELT) |
| e. Reactor power is 100%,
BSCAL and BDELT have failed | 5. Calibrated BTFSP (CBTFSP) |
| f. Reactor power is 100%,
CBDELT and CBTFSP have failed | |

QUESTION 3.08 (1.50)

The CPC's provide what three (3) indications on the main control boards?

(1.5)

QUESTION 3.09 (2.00)

- a. Which CPC trip has a "projected" calculation? (0.5)
- b. What two (2) parameters are "projected"? (1.0)
- c. Why is "projection" not required for other parameters in the CPC trip calculations? (0.5)

QUESTION 3.10 (1.50)

- a. What will cause a Steam Generator Level Deviation Alarm? (0.5)
- b. What action(s) occur as a result of a Steam Generator Level Deviation Alarm? (1.0)

QUESTION 3.11 (2.50)

- a. When is a quick-opening block generated for the turbine bypass valves? Be specific as to which valves require specific inputs, if applicable. (1.5)
- b. The plant is being started up with #1 and #2 bypass valves open. The #2 CONDENSER AVAILABLE signal is lost. How does the SBCS respond? (1.0)

QUESTION 4.01 (3.00)

For EACH of the immediate action steps below, taken from OP902-000, Emergency Entry Procedure, list ALL of the specific indications to be observed or actions to be taken to satisfy the immediate action requirement. Contingency actions are not required. (3.0)

- a. Check feedwater control in Reactor Trip Override.
- b. IF pressurizer pressure $\leq$ 1684 psia on 2 out of 4 channels OR containment pressure $\geq$ 17.1 psia on 2 out of 4 channels, THEN check SIAS occurred.
- c. Check for turbine trip.

QUESTION 4.02 (1.50)

Following a reactor trip, what two (2) conditions require that ALL reactor coolant pumps be stopped? (1.5)

QUESTION 4.03 (3.00)

List the indications that must be checked to verify natural circulation. Include numerical values where specified in the EOP's. (3.0)

QUESTION 4.04 (1.50)

OP-010-001, General Plant Operations, directs that CEA withdrawal during power operation should be in small, frequent steps (less than 3 inches). HOW and WHAT does this operational requirement prevent? (1.5)

QUESTION 4.05 (2.00)

List the immediate actions for Inadvertent Safety Injection/Containment Isolation. (2.0)

QUESTION 4.06 (2.00)

What are the immediate actions taken by the control room operators when the order to evacuate the control room is given with the plant at power? (2.0)

QUESTION 4.07 (3.00)

- a. A large leak in the CCW system has occurred. Basically, how is the header containing the leak identified? (1.5)
- b. What actions should be taken if CCW flow has been lost to the Nonsafety loop (A/B) and cannot be restored within 3 minutes? (1.5)

QUESTION 4.08 (1.50)

Give three (3) restrictions in effect when all RCP's and Shutdown Cooling Pumps are secured. (1.5)

QUESTION 4.09 (2.50)

During a reactor startup, the reactor achieves criticality at a CEA height equivalent to 0.55% below the ECC. What action(s) should be taken, if any? (2.5)

QUESTION 4.10 (1.00)

List the four (4) emergency classifications, per the Emergency Plan, in order of increasing severity. (1.0)

QUESTION 4.11 (2.00)

Match the condition (a - d) with the appropriate rate limit (1 - 5). (2.0)

- | | |
|----------------------------|-----------------------|
| a. 440 deg F, heating up | 1. 10 deg F per hour |
| b. 280 deg F, heating up | 2. 30 deg F per hour |
| c. 360 deg F, cooling down | 3. 50 deg F per hour |
| d. 190 deg F, cooling down | 4. 60 deg F per hour |
| | 5. 100 deg F per hour |

QUESTION 4.12 (2.00)

- a. Write an equation expressing the relationship between RAD, REM, and QUALITY FACTOR. (1.0)
- b. What are the "Quality Factors" for the various kinds of radiation that may be present at W3SES? (1.0)

NRC LICENSE EXAMINATION HANDOUT

EQUATIONS, CONSTANTS, AND CONVERSIONS

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

$$\dot{Q} = U * A * \Delta T$$

$$P = P_0 * 10^{\text{SUR} * (t)}$$

$$P = P_0 * e^{t/T}$$

$$\text{SUR} = 26/T$$

$$T = 1^*/p + (\beta - p)/\bar{\lambda} p$$

$$T = 1/(p - \beta)$$

$$T = (\beta - p)/\bar{\lambda} p$$

$$p = (K_{\text{eff}} - 1)/K_{\text{eff}} = \Delta K_{\text{eff}}/K_{\text{eff}} \quad p = 1^*/TK_{\text{eff}} + \bar{\beta}_{\text{eff}}/(1 + \bar{\lambda} T)$$

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

$$\bar{\lambda} = 0.1 \text{ seconds}^{-1}$$

$$I = I_0 * e^{-\lambda x}$$

$$\text{CR} = S/(1 - K_{\text{eff}})$$

$$R/\text{hr} = 6 * CE/d^2 \text{ feet}$$

Water Parameters

$$1 \text{ gallon} = 8.345 \text{ lb}_m = 3.87 \text{ liters}$$

$$1 \text{ ft}^3 = 7.48 \text{ gallons}$$

$$\text{Density @ STP} = 62.4 \text{ lb}_m/\text{ft}^3 = 1 \text{ gm/cm}^3$$

$$\text{Heat of vaporization} = 970 \text{ Btu/lb}_m$$

$$\text{Heat of fusion} = 144 \text{ Btu/lb}_m$$

$$1 \text{ atmosphere} = 14.7 \text{ psia} = 29.9 \text{ inches Hg.}$$

Miscellaneous Conversions

$$1 \text{ curie} = 3.7 \times 10^{10} \text{ disintegrations per second}$$

$$1 \text{ kilogram} = 2.21 \text{ lb}_m$$

$$1 \text{ horsepower} = 2.54 \times 10^3 \text{ Btu/hr}$$

$$1 \text{ mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

$$1 \text{ inch} = 2.54 \text{ centimeters}$$

$$\text{degrees F} = 9/5 \text{ degrees C} + 32$$

$$\text{degrees C} = 5/9 (\text{degrees F} - 32)$$

$$1 \text{ Btu} = 778 \text{ ft-lb}_f$$

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 1.01 (2.00)

Concentration increases (0.5) and reactivity increases (0.5) due to boron reduction over core life reducing competition for neutrons (0.5) and flux increasing as a function of core age (0.5).

REFERENCE

Basic Reactor Theory

ANSWER 1.02 (1.00)

The neutrons that were off-resonance are now being absorbed in increasing numbers due to absorption cross section increasing in the previously off-resonance range (1.0).

REFERENCE

Standard Reactor Theory

ANSWER 1.03 (2.00)

- a. The delayed neutron fraction decreases (0.333) due to Plutonium producing fewer delayed neutrons than U 235 (0.333). (accept B for Plutonium < B for U 235 for second part of answer)
- b. SUR would increase (0.333) for a given reactivity change because of a smaller delayed neutron input (0.333).
- c. The doppler defect would increase (0.333) because of the production of Pu 240 (0.333), a high cross section resonant absorber. (This is outweighed overall by the decrease in fuel temp., a positive effect)

REFERENCE

Standard Reactor Theory

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 1.04 (3.00)

1. Temperature - Neutrons travel longer distance at higher temperature, therefore, higher probability of capture.
2. Boron concentration - As concentration goes up, fewer neutrons reach the rods.
3. Fission product poisons - As poison concentration increased fewer neutrons reach the rods.
4. Rod shadowing - When adjacent rods are inserted, the existing rod sees a lower flux.
5. Radial position - Rods near the center of the core see higher flux than peripheral rods.
6. Axial position - The farther a rod is inserted into the core, the greater the flux to which it is exposed.
7. Core age - As the core ages, boron is reduced which causes rod worth to increase.
8. Anti-shadowing - An inserted rod suppresses the nearby flux but causes a flux peak further out. A rod inserted into this peak will have a higher worth.

(4 required at 0.25 for each factor/condition and 0.5 for each explanation)

REFERENCE
CE EQB

ANSWER 1.05 (1.50)

This thermal power is mainly from the decay of fission products (0.5). It does not indicate on the nuclear instrumentation because it consists mainly of alpha, beta, and gamma radiation from the decay of the fission products, which are not detected on the nuclear instrumentation (1.0).

REFERENCE
Standard Reactor Theory

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 1.06 (3.00)

- a. The core maximum linear power will increase (0.5). Total core power does not change. The linear power near the dropped CEA will decrease (0.5), but the rest of the core will be producing a higher linear power (0.5).
- b. Xenon will build in near the inserted CEA due to burnout decreasing (0.5). This will further suppress power generation in this area (0.5), and cause the maximum linear power to increase elsewhere in the core (0.5).

REFERENCE

Basic Reactor Theory

ANSWER 1.07 (2.50)

Tave = 563.5 deg F + or - 1 deg initially (0.3)

Tave = 572.5 deg F + or - 1 deg final (0.3)

power defect at 50% = -0.75% delta k (0.3) (accept -0.73 to -0.77%)

power defect at 75% = -1.09% delta k (0.3) (accept -1.07 to -1.10%)

-1.09% - (-0.75%) = -0.34% added due to the power increase (0.5)
(accept -0.3 to -0.37%)

85.2 ppm = 1% delta k (0.3) (accept 83.9 to 85.4 ppm)

85.2 ppm X (-0.34%) = -29 ppm (0.5) (accept 25 - 32 ppm)

REFERENCE

Waterford 3 Plant Data Book, Sections 1.2.1 Rev 0, 1.4.4.1 Rev 0,
2.2.1 Rev 7

ANSWER 1.08 (.50)

d (0.5)

REFERENCE

Standard Fluid Flow Principles

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 1.09 (2.00)

- a. decrease (0.5)
- b. decrease (0.5)
- c. increase (0.5)
- d. increase (0.5)

REFERENCE

Standard Fluid Flow and Pump Principles

ANSWER 1.10 (2.50)

- a. Nucleate boiling is most likely to start at the top of the core or fuel assembly (0.5) because this is the hottest part of the core and therefore nearer saturation conditions. (1.0)
- b. At the onset of nucleate boiling the heat transfer rate increases (1.0) (due to the removal of the heat of vaporization and the break up of the laminar layer at the clad surface).

REFERENCE

Basic Thermodynamics and Core Characteristics

ANSWER 1.11 (1.00)

- heat source
- heat sink
- elevation difference between source and sink
- thermal driving head between source and sink (dT or density difference) (0.25 each)

REFERENCE

PWR Natural Circulation Handout

ANSWER 1.12 (2.00)

- a. Decrease (0.5)
- b. Increase (0.5)
- c. Decrease (0.5)
- d. No change (0.5). Accept increase if the assumption is stated that increasing pressure decreases nucleate boiling.

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

PAGE 19

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

REFERENCE

PWR Thermal Sciences FND-121, Lesson d-6, pg 15-17

ANSWER 1.13 (2.00)

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

REFERENCE

PWR Thermal Sciences, Lesson D-6, pgs 14-15

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 2.01 (3.00)

- a. upper gripper (0.5)
- b. Should the current decrease below a minimum setpoint, the voltage to the engaged gripper is reinitialized (0.5), and an immediate attempt to transfer to the opposite (lower) gripper (0.5) is made. If the transfer is successful, the voltage to the original gripper is shut off (0.5). If the transfer is unsuccessful, it will be re-attempted four times (0.5). If still unsuccessful after the fourth attempt, high voltage alarms will be generated (0.5).

REFERENCE

CEDMCS Lesson Plan, pg 21

W321434-20017, Inadequate Holding Current

ANSWER 2.02 (3.50)

- a. normal: condensate storage pool (0.5)
backup: ACCW wet tower basin (0.5)
- b. manually (0.5)
- c. electrical overspeed resets automatically (0.5)
mechanical overspeed must be manually reset (0.5)
- d. motor operated (0.5)
- e. fails as is (0.5)

REFERENCE

Emergency Feedwater System Description, pg 3, 5, 8

ANSWER 2.03 (2.00)

- by reducing the differential pressure between the containment atmosphere and the environment (1.0)
- by a reduction of iodine in the post accident containment atmosphere(1.0)

REFERENCE

Containment Spray System Description, pg 1

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 2.04 (2.50)

- a. Dry cooling towers (0.5)
- b. As the CC temperature increases, the dry cooling tower fans sequence on (0.5). As temperature continues to increase, the ACC pumps start (0.5), providing cooling to the CCW HX (0.5). As ACCW temperature increases, the wet tower fans sequence on (0.5) to control the wet cooling tower basin temperature.

REFERENCE

CCW System Description, pg 6-8

ANSWER 2.05 (2.50)

- a. Hydrogen recombiners (0.2) cause the free hydrogen to recombine with oxygen to form water (0.3). The Containment Atmosphere Release System (0.2) is used to purge the containment atmosphere to the containment annulus (0.3).
- b.
 - Radiolysis of water (0.5)
 - Zr-water reaction (0.5)
 - Corrosion of metals in containment (0.5).

REFERENCE

Hydrogen Control System Description, pg 2, 4, 12, 23

ANSWER 2.06 (2.00)

- a. 4
 - b. 6
 - c. 5
 - d. 1
- (0.5 each)

REFERENCE

Fire Protection System Description, pg 65-66

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 2.07 (2.50)

- a. The RCP controlled bleedoff header relief valve opens (1.0) to direct the bleedoff flow to the quench tank.
- b. Cools (0.25) and lubricates (0.25) the RCP mechanical seals (0.5)
- c. CCW (0.5)

REFERENCE

RCS Description, pg 31

CVCS Description, pg 25

ANSWER 2.08 (1.00)

The AB Bus supply breakers require a key to shut. Only one key is provided for the two breakers and the breaker cannot be shut without the key, therefore only one can be shut at any one time (1.0).

REFERENCE

4160 Distribution System Description, pg 56c-13

OP-6-001

ANSWER 2.09 (2.00)

- a. open (0.5)
- b. improper (0.5). This could result in HPSI pump runout (0.5).
- c. 50% (+ or - 5%) to each path (0.5).

REFERENCE

SI System Description, pg 13

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

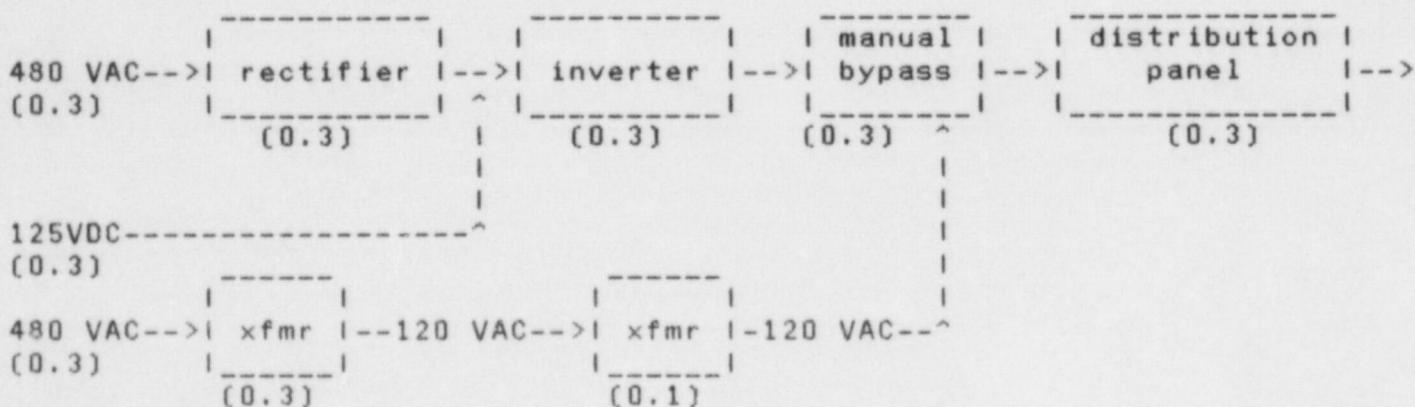
ANSWER 2.10 (1.50)

- a. generator differential (0.5)
engine overspeed (0.5)
- b. The ENGINE STOP and EMERGENCY STOP pushbuttons must be depressed simultaneously locally (0.5).
Also accepted: Place engine Control Switch (START/STOP) in the control room to stop OR trip engine overspeed trip device locally on the diesel.

REFERENCE

EDG System Description, pg 25

ANSWER 2.11 (2.50)



REFERENCE

Inverters and Distribution System Description, fig. 59-2

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 3.01 (2.00)

- four sensors (0.125) are CPC inputs (0.25) for RCS flow determination (0.25)
- two sensors (0.125) are COLSS inputs (0.25) for RCS flow determination (0.25)
- one sensor (0.125) provides start and stop signals to the oil lift pumps (0.25)
- one sensor (0.125) provides zero speed indication (0.25)

REFERENCE

RCS System Description, pg 61-62

ANSWER 3.02 (3.00)

[Indicated pressurizer level indicates high.] The letdown valves open to max letdown (0.6). The pressurizer heaters energize due to the high level error signal (0.6). Actual pressurizer level is decreasing (0.6) and primary pressure is decreasing with level (0.6). A reactor trip occurs due to low pressure (0.6). At 28% on the operable level indicator, the pressurizer heaters turn off IF BOTH is selected on the heater cutout selector switch.

REFERENCE

Pressurizer Pressure and Level Control System Description, pg 23-24

ANSWER 3.03 (2.00)

Two thermocouples are placed in the same general location (0.5). A heater is located adjacent to one of the thermocouples (0.5). In a vapor/steam environment, the thermocouple located nearest the heater will indicate a higher temperature (0.5). When the detector is covered with water, the water carries the heater's heat away, and very little, if any, temperature difference exists between the two thermocouples (0.5).

REFERENCE

Reactor Vessel and Internals System Description, pg 23

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 3.04 (2.00)

- a. Turn the control switch for the pump to the START position, then off (0.5).
- b. The operator has complete control of the pump (the pump will not start/stop automatically in response to automatic signals) (1.0).
- c. breaker trouble (0.5) such as springs not fully charged, trip input exists, closing power not available, etc.

REFERENCE

SI System Description, pg 20, 26

ANSWER 3.05 (2.50)

- a. The LPSI pumps will be running (0.25) on recirc, RWSP to RWSP (0.25).
- b. The LPSI pumps trip (1.0).
- c. The LPSI pump switch is turned to the STOP position (0.5).
- d. by resetting the original RAS (0.5).

REFERENCE

SI System Description, pg 28-29

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 3.06 (3.00)

Startup (Bypass) Feed Regulating Valve:

- Starts opening when flow demand increases above 0% (0.25)
- Linear operation, 100% open at ~ 22% flow demand (0.5)

Main Feed Regulating Valve

- Stays shut until ~22 % flow demand, then snaps open to ~5% (0.5)
- Snaps shut at less than ~2% flow demand (0.25)
- Valve response above ~22% is linear to 100% flow demand (0.5)
(a slight change in slope occurs at approximately 40% flow demand)

Main Feed Pump Speed:

- Minimum speed (~3900 rpm) below ~37.5% flow demand (0.5)
- Linear response above ~37.5% flow demand until max speed (~5200 rpm) reached at 100% flow demand (0.5)

Also accept sketch of programs as alternate answer.

REFERENCE

FWCS Description, pg 7-9, Fig. 3

ANSWER 3.07 (3.00)

- a. larger of 1 and 3 (0.5)
- b. larger of 4 and 5 (0.5)
- c. larger of 1 and 3 (0.5)
- d. 4 (0.5)
- e. 3 (0.5)
- f. 2 (0.5)

REFERENCE

COLSS System Description, pg 20-22, Fig. 14 and 14A

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 3.08 (1.50)

- Margin to DNBR (0.5)
- Margin to LPD (0.5)
- Calibrated linear power OR calibrated neutron flux power (0.5) either wording acceptable

REFERENCE

CPC System Description, pg 17

ANSWER 3.09 (2.00)

- a. DNBR (0.5)
- b. RCS flow (0.5) and RCS pressure (0.5)
- c. Other parameters in the calculations can not change fast enough to require protection (0.5).

REFERENCE

CPC System Description, pg 28-29

ANSWER 3.10 (1.50)

- a. If the two levels on a S/G differ (0.25) by >13" (7.2%) (0.25)
- b. M/A stations for the Feedwater pumps, BRV, and MRV on that FWCS shift to manual (1.0).

REFERENCE

FWCS Description, pg 29

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 3.11 (2.50)

- a. Valve #6 is blocked whenever a reactor trip is received (0.5).
Valves 1 - 5 are blocked on a reactor trip (0.5) if Tave is
<566 deg F (0.5).
(Recent test results indicate that the Reactor Power Cutback System
provides a Q. O. Block Signal to all 6 valves if the event was
initiated by a loss of feedpump. Not required in answer, but
acceptable.)
- b. The BPVs that were open will fast close (1.0).

REFERENCE

SBCS Description, pg 22, 26

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 4.01 (3.00)

- a. MAIN FW (FW 173A) CLOSED
MAIN FW (FW 173B) CLOSED
STARTUP FW REG (FW 166A) 5% FLOW DEMAND
STARTUP FW REG (FW 166B) 5% FLOW DEMAND
FEEDWATER TURBINE A SPEED MINIMUM
FEEDWATER TURBINE B SPEED MINIMUM
- b. Two of three charging pumps (A,B,AB) started
One HPSI AND LPSI pump in each train started
TRAIN A HPSI COLD LEG INJECTION VALVE 1A (SI 225A) OPEN
1B (SI 226A) OPEN
2A (SI 227A) OPEN
2B (SI 228A) OPEN
TRAIN A LPSI FLOW CONTROL VALVE COLD LEG 2A (SI 139A) OPEN
2B (SI 138A) OPEN
TRAIN B HPSI COLD LEG INJECTION VALVE 1A (SI 225B) OPEN
1B (SI 226B) OPEN
2A (SI 227B) OPEN
2B (SI 228B) OPEN
TRAIN B LPSI FLOW CONTROL VALVE COLD LEG 1A (SI 139B) OPEN
1B (SI 138B) OPEN
CIAS OCCURS
- c. Governor valves closed
Throttle valves closed
Reheat valves closed
Intercept valves closed

{25 at 0.12 each}

REFERENCE

W3SES OP-902-000, Rev 1, pg 2, 5-7

ANSWER 4.02 (1.50)

- Pressurizer pressure $\leq$ 1621 psia following an SIAS
 - Loss of CCW to RCPs for $\geq$ 3 min.
 - Upon receipt of a CSAS
- {2 required at 0.75 each}

REFERENCE

W3SES OP-902-002

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 4.03 (3.00)

1. Loop dT <64 deg F (0.3)
2. Cold leg temperature constant OR dropping (0.3)
3. Hot leg temperature constant OR dropping (0.3)
4. Core temperature AND hot leg temperature dT <10 deg F (0.3)
5. Steam Generator pressure ~ = saturation pressure for existing Tc (0.3)
6. Both S/G are:
 - a. Wide Range level >50% (0.3) AND (0.1) constant or rising (0.3)
OR (0.1)
 - b. Level is being restored by > or = 0.378 X 10E6 lbm per hour MFW flow (0.3) OR (0.1) > or = 150 gpm EFW flow (0.3).

REFERENCE

W3SES OP-902-002, pg 10

ANSWER 4.04 (1.50)

This will reduce the possibility of fuel failure (0.5) due to large local power densities (0.5) in the vicinity of the CEA finger tips. (0.5)

REFERENCE

OP-10-001, Rev 6, pg 14

CE GENERIC CHARACTERISTICS

ANSWER 4.05 (2.00)

1. Pressurizer level is BOTH (0.125):
 - a. =>28% (0.25)
 - b. Constant or rising (0.25)
2. RCS subcooling margin =>28 deg F (0.25)
3. BOTH steam generators are satisfying either (0.125):
 - a. Steam generator level wide range is BOTH
 - 1) =>50% (0.25)
 - 2) constant or rising (0.25)

OR

 - b. Level is being restored by either;
 - 1) main feedwater flow OR (0.25)
 - 2) emergency feedwater flow (0.25)

REFERENCE

W3SES OP-901-042, Inadvertent SIAS/CIAS, Rev 2, pg 3-4

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 4.06 (2.00)

The primary operator (0.25) will:

1. trip the reactor and verify all CEAs are inserted (0.25).
2. verify spray valve selector switch in the BOTH position (0.25).
3. proceed to LCP -43 (0.25).

The secondary operator (0.25) will:

1. verify the turbine and generator are tripped (0.25).
2. reset the moisture separator reheater controls (0.25).
3. proceed to RAB +35 relay room (0.25).

REFERENCE

W3SES OP-901-004, Rev 2, pg 5

ANSWER 4.07 (3.00)

- a. Ensure the headers are isolated (0.5).
Whichever level is decreasing, A or B, that loop contains the leak (0.5)
If surge tank level recovers, the leak is in the nonsafety header (0.5)
- b. Trip the reactor
Stop all RCP's
Enter OP-902-000 (Reactor Emergency Entry Procedure)
(3 at 0.5 each)

REFERENCE

OP-901-039, CCW Malfunction, Rev 2, pg 13

ANSWER 4.08 (1.50)

- maximum time of one hour
 - no operation is permitted which could cause dilution of the RCS
 - core outlet temperature shall be maintained at least 10 deg subcooled
 - one hour per eight hour period if handling fuel in vicinity of hot legs
- (3 required at 0.5 each)

REFERENCE

OP-10-001, General Plant Operations, Rev 6, pg 11

4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND
RADIOLOGICAL CONTROL

PAGE 32

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 4.09 (2.50)

Insert CEA's (0.5) to take the reactor subcritical by 1% dk/k (0.5).
Recalculate the ECC (0.5). Verify the boron concentration (0.5)
and CEA position (0.5).

REFERENCE

OP-10-001, General Plant Operations, Rev 6, pg 59

ANSWER 4.10 (1.00)

Unusual Event
Alert
Site Area Emergency
General Emergency
(0.2 for each class, 0.2 for the order)

REFERENCE

EP1-001, Recognition and Classification of Emergency Conditions, Rev 9,
pg 5

ANSWER 4.11 (2.00)

a. 4
b. 3
c. 5
d. 2
(0.5 each)

REFERENCE

Waterford 3 Technical Specification 3.4.8

ANSWERS -- WATERFORD 3

-86/08/19-GRAVES, D.

ANSWER 4.12 (2.00)

a. RAD X QUALITY FACTOR = REM (1.0)

b. Gamma or X rays - 1
Beta - 1
(Internal) Alpha - 20
Thermal neutrons - 3
Fast neutrons - 10
(0.2 EACH)

REFERENCE

General Radcon

WATERFORD - 3 SES
TRAINING DEPARTMENT COMMENTS ON
NRC LICENSE EXAMINATIONS
ADMINISTERED ON AUGUST 19, 1986

Prepared By DP Clel, 8/21/86
Date

Reviewed By CM [Signature], 8/21/86
Date

Approved By D. [Signature], 8/21/86
Date

COMMENTS ON
REACTOR OPERATOR
NRC LICENSE EXAMINATION

CATEGORY 1

1.01 Comment

Change "Concentration decreases" to read "Concentration increases".

Basis

The Waterford-3 core design results in this effect.

Refer to Attachments 1.01a and 1.01b showing Waterford-3 plant physics data and a plant-specific calculation of Nxe done for the training class. Also based on values candidates may indicate that increase is slight.

1.02 Comment

Delete "and 2) Fuel pellet self shielding has decreased."

Basis

Self shielding theory was not stressed at Waterford-3 for this group. As a result of our on-going job analysis, it has been determined that this knowledge item is necessary to upgrade the operators' theory background. The ongoing and future operator licensing classes will be responsible for this theory.

1.03a. Comment

Insert behind U-235 in parentheses: Accept Beta for Plutonium is lower than U-235).

Basis

This is a common way of expressing the same statement.

1.04 Comment

Items 1, 7, and 8 on answer key refer to worth. Accept "more flux reaches the CEA".

Basis

Question requested "factors or conditions which affect flux reaching a particular CEA."

CATEGORY 1 (Continued)

1.07 Comment

Accept reasonable ranges on power defect and inverse boron worth within the limits of TAVG allowed in answer key.

Recommended ranges:

Power Defect at 50% = $-0.75\% \frac{\Delta k}{k}$ (Accept -0.73% to -0.77%)
Power Defect at 75% = $-1.09\% \frac{\Delta k}{k}$ (Accept -1.07% to -1.10%)

$\Delta \rho$ PD = -0.34% (Accept 0.3% to 0.37%)

IBW = $\frac{84.5 \text{ ppm}}{1\% \frac{\Delta k}{k}}$ (Accept 83.9 ppm to 85.4 ppm)

Calculation

$\Delta \text{ppm} = (84.5 \text{ ppm}/\% \frac{\Delta k}{k})(-0.34\% \frac{\Delta k}{k}) = 29 \text{ ppm}$ (Accept 25 to 32 ppm)

NOTE: Value based on PD and IBW values interpolated from graphs.

Basis

Range should be given to allow for reasonable interpolation within Tavg band allowed. Also average IBW would normally be used for this type of calculation, however, acceptable practice is to use either initial or final condition values for IBW due to minimal error produced.

1.11 Comment

Change answer to read:

- Heat source
- Heat sink
- Elevation difference between heat source and heat sink
- Thermal driving head between heat source and heat sink (ΔT or density difference)

Basis

This information is what the candidates were trained on. Refer to Attachment 1.11 (2 pages).

END OF CATEGORY 1

CATEGORY 2

2.04b. Comment

Delete first required response on answer key.

"As the CC temperature increases, the dry cooling tower fans sequence on."

Basis

Question does not solicit this response. The "other components/systems" are requested. The Dry Cooling Tower Fans are considered part of the Dry Cooling Towers requested in part a of this question.

2.05b. Comment

Delete "by the caustic spray" on the answer key.

Basis

Question requested sources only. Actually spray is acidic until RAS occurs. Also corrosion of metals occurs due to the high temperature steam environment even if containment spray is terminated.

2.08 Comment

Delete question from examination.

Basis

This is not a Waterford-3 Design Feature. Actually the AB Components (e.g. HPSI pump, CC pump etc.) are powered from a separate bus (AB bus) thus kirk keys are not required for these AB component since they only have one breaker. However, the AB Buses do utilize kirk keys to prevent crosstieing of safety buses. This information was in the Safety Injection System Description and will be corrected. However, refer to Safety Injection System Lesson Plan L-124-053-00 Pages 8 and 9 for confirmation.

2.09c. Comment

Place parentheses around "+ or - 5%".

Basis

Design of system is to divide hot and cold leg injection evenly. Question does not state to provide allowable range.

CATEGORY 2 (Continued)

2.10b Comment

Change answer to "Place engine (start/stop) control switch to stop."
Also accept "Trip the engine overspeed trip device (this also shuts
off the Air supply butterfly damper) at the diesel."

Basis

Corresponds to information received by candidates during license
training classes.

Refer to CWD 2318 (Diesel Generator Engine Control Interface Sheet 1)
and EMDRAC 1564-2171 (Cooper Bessemer Control Schematic) which are
attached.

END OF CATEGORY 2

CATEGORY 3

3.02 Comment 1

Place parentheses around first sentence in answer key. "(Indicated pressurizer level indicates high.)"

Basis 1

This response is not solicited for describing plant response. In addition not all pressurizer level indications fail high.

Comment 2

Change "The letdown valves open fully" to read "The letdown valves open to maximum letdown (128 gpm)."

Basis 2

During automatic operation the maximum flowrate is limited. Refer to Pressurizer Pressure and Level Control System Description, page 7 Paragraph A.1.3.1.3.

Comment 3

CAF was requested on answer key concerning pressurizer heater response. "The heaters trip when the other level channel reaches 28% (if BOTH is selected on the Heater Cutout Selector Switch). However, no points are awarded for this statement anyway.

Basis 3

Refer to Pressurizer Pressure and Level Control System Description, pages 16 and 17 Paragraphs A.3.2.3.1 and A.3.2.3.2.

3.05b. Comment

Delete "The recirculation valves go shut (0.5) and"

Alter point value for "the LPSI pumps trip to 1.0.

Basis

The recirculation valves no longer close on RAS due to a station modification (DCN-IC-1448). These valves are now operator controlled. Refer to the attached CWD-LOU-1564-B-424 Sheet 516S (Before and After) showing one of these recirculation valves.

CATEGORY 3 (Continued)

3.05d. Comment

Delete "at the ESFAS panel". (Actually this action would require reset at CP-10 first and then reset at either CP-33 or the Aux Relay (ESFAS) Panels.)

Basis

Question does not solicit location for actions. Concerning typical ESFAS reset actions refer to OP-902-002 Page 39 CSAS Reset.

3.06 Comment

Replace answer key with the following response:

Startup (Bypass) Feed Regulating Valve

- 1) Starts opening when flow demand increases above 0% FD (Flow Demand)
- 2) linear operation, 100% open at ~ 22% FD (21.88%) signal.

Main Feed Regulating Valve

- 1) Stays shut until ~ 22% FD (21.9%) signal is reached then snaps open to ~ 5%.
- 2) Snaps shut at less than ~ 2% FD.
- 3) Valve response above ~ 22% FD (21.9%) is linear to 100% FD (Note that a slight change in slope occurs at approximately 40% FD).

Main Feed Pump Speed

- 1) Minimum speed (~ 3900 RPM) below ~ 37.5% FD.
2. Linear increase above ~ 37.5% FD until reach maximum speed (~ 5200 rpm) at 100% FD.

Also accept sketch of programs as alternate answer.

Basis

New valve and pump speed programs were implemented for the Feedwater Control System. This information is incorporated in Lesson Plan L-124-024-00, Pages 4 - 6. Figures showing these new programs are provided on Attachments 3.06a, 3.06b, and 3.06c.

CATEGORY 3 (Continued)

3.08 Comment

Accept "Calibrated neutron flux power" as optional designation for "Calibrated linear power."

Basis

Terms are used interchangeable at Waterford 3. Refer to Page 73 (Section 4.2.1 Part 3, Indication) and Figure 60 of the Core Protection Calculator System Description.

3.10a. Comment

Alter answer key as follows:

"If the two levels on a S/G differ (0.25) by $> 13''$ (or 7.2%)(0.25).

Basis

Question does not solicit setpoint (magnitude of deviation) directly. Question requests what will cause the alarm. Points should be awarded for knowledge that the deviation is between the two level indications and not deviation from the programmed setpoint. Also either setpoint should be adequate since they represent the same deviation value.

3.10b. Comment

Change "pumps" to "pump" on answer key.

Basis

Pumps would imply both shift to manual. Refer to FWCS Description, Page 29, Section 3.3.3, Part 4.

3.11a. NOTE

The Reactor Power Cutback Test performed recently at Waterford-3 resulted in new information that the RPCS provides a quick open block signal to all 6 valves if the event was initiated by a loss of Feedpump.

Some candidates may be aware of this signal, however, formal training on this new information has not yet been completed for all Operations personnel.

END OF CATEGORY 3

CATEGORY 4

4.01 Comment (Parts a and b)

- a. Accept "Both" in cases where 2 Trains of components are required to actuate (e.g. MRFV's)
- b. Accept reasonable description of HPSI and LPSI Injection Valves operated (e.g. the 4 HPSI CLI Valves open).

Basis

Objective of question is to determine knowledge of required actions vice verbatim repeat back of procedural steps. As presently written, the answer key could result in loss of 1.32 points (44% of question value) for non-verbatim response. The valves listed in part b alone account for 1.44 points (48% of the total question value).

4.02 Comment

Expand answer to include receipt of a CSAS (Containment Spray Actuation Signal) as one of the two possible required responses.

Basis

Due to new design modification, CCW is automatically secured to the RCP's on a CSAS. This requires immediate trip of the RCP's since CCW flow cannot be restored before exceeding 3 minutes. Refer to CCW System Lesson Plan (L124-009-00 Page 19) for design modification information. This modification and RCP Trip Criteria has been incorporated in the upcoming Revision of the FBEOP's. The candidates have been trained on these procedures in preparation for the anticipated implementation of the new revision.

4.04 Comment

Accept concept and equivalent alternate descriptions of worsened core conditions in the vicinity of CEA finger tips.

Basis

Various terminology can be used to explain the phenomena asked about.

CATEGORY 4 (Continued)

4.07b. Comment

Delete "Secure letdown, secure charging and periodically monitor pressurizer level" from answer key.

Also place parentheses around Procedure title (Emergency Entry Procedure).

Basis

Upon entry into the Emergency Entry Procedure the operator is directed by only that procedure, thus any other subsequent actions will be determined by the FBEOP's.

4.08 Comment

Add "During refueling one hour per eight hour period if handling fuel in vicinity of hot legs".

Basis

Answer key should accept all allowable restrictions since a specific plant condition was not given. This restriction is located in Technical Specifications and the Refueling Procedure (OP-10-002).

4.12b. Comment

Delete "Internal" from the phrase "Internal Alpha".

Basis

Alphas are normally considered an internal hazard therefore that specific term should not be required.

COMMENTS ON
SENIOR REACTOR OPERATOR
NRC LICENSE EXAMINATION

CATEGORY 5

5.02.b. Comment

Delete present answer and replace with:

"Maintain ASI close to expected ESI since ASI will shift positive due to density (temperature) effects on flux.

Basis

Present answer is true, but not solicited by question. Operation is allowed with a less restrictive initial DNBR when COLSS is out of service (Reference Figures 3.2-2 and 3.2-3 of Technical Specifications) due to more rapid response by the CEA's to reduce flux. The ASI LCO and if necessary CPC DNBR or Auxiliary Trip on ASI ensures core protection is maintained. The recommended answer is more appropriate for the question asked.

5.03 Comment

Add the following to possible response.

- Fuel pellet cracking (contact) - decrease

Basis

This mechanism is known to occur and as such has been stressed to the students at Waterford-3 SES. In addition, a question on this concept is on file as an acceptable response on exams given to this training class. Reference - Exam Category 5 Answer Key W360048-60002 on file at Waterford -3.

5.04 Comment 1

From figures 1.4.5.2 and 1.4.2 calculated values of Inverse Boron Worth could range from 78.5 to 81.5 ppm/% $\Delta k/k$ since Figure 1.4.5.1 was not provided. This would allow values of -0.123 to -0.127% $\Delta k/k$ for negative reactivity added. An alternate method is to accept a reasonable thumbrule value. Recommended range is 76 to 83 ppm/% $\Delta k/k$. This would allow values of -0.119 to -0.132% $\Delta k/k$ for reactivity added.

Basis 1

Curve necessary for a more exact calculation was not included.

CATEGORY 5 (Continued)

5.04 Comment 2

Accept -1.67 to $-1.73\% \Delta k/k/^{\circ}F$ for MTC value.

Basis 2

Allow interpolation error when reading the curve provided (Figure 1.2.5.1).

Comment 3

Acceptable temperature decrease should be within the various tolerances allowed due to the calculation or assumption made for Boron Worth (or Inverse Boron Worth) as stated in Comment 1 and the value obtained for MTC as stated in Comment 2.

Basis 3

The two items discussed in Comments 1 and 2 will directly affect the calculated temperature decrease.

Comment 4

Final Tave should be value based on $582^{\circ}F$ - value of temperature decrease calculated.

Basis 4

Same as Basis 3.

5.05a. Comment

Expand answer to also accept that core delta T INCREASES as T_h goes up due to continued decay heat addition (with no further flow).

Basis

For effective single phase natural circulation the core is initially subcooled (e.g. as per effective natural circulation criteria of the EOP's a minimum subcooling of $28^{\circ}F$ should be present). The boiling cited in the answer key only occurs after temperatures increase to saturation conditions.

CATEGORY 5 (Continued)

5.05b. Comment

Expand answer to also accept that core thermocouple temperature INCREASES due to continued decay heat addition (with no flow) or loss of heat removal.

Basis

Same as for 5.05a above; plus accept use of equivalent terminology.

5.05c. Comment

Expand answer to also accept alternate terminology such as "Steam generator pressure DECREASES due to no further heat addition to the steam generator from the core" or equivalent.

Basis

Various terminology can be used to correctly describe the phenomena asked about.

5.06 Comment

Change "Concentration decreases" to read "Concentration increases".

Basis

The Waterford-3 core design results in this effect. Refer to attached pages showing Waterford-3 plant physics data and a plant-specific calculation of Nxe done for the training class. Also based on values candidates may say increase is slight.

5.07 Comment

Delete "and 2) Fuel pellet self shielding has decreased."

Basis

Self shielding theory was not stressed at Waterford-3 for this group. As a result of our on-going job analysis, it has been determined that this knowledge item is necessary to upgrade the operators' theory background. The ongoing and future operator licensing classes will be responsible for this theory.

CATEGORY 5 (Continued)

5.08.a. Comment

Insert behind U-235 in parentheses: (accept Beta for Plutonium is lower than U-235).

Basis

This is a common way of expressing the same statement.

END OF CATEGORY 5

CATEGORY 6

6.01 Comment

Add additional response "if A/B pump selector switch selected to A with A/B bus powered from B side or vice-versa."

Basis

This is part of current alarm scheme for all A/B safety related equipment, but is not yet in the system description.

6.02 Comment 1

a. Change 93% to 89%.

Basis 1

Current plant HLO setpoint as per the Setpoint Document.

Comment 2

b. Accept both pumps go to minimum speed if student assumes both steam generators go to HLO at the same time. Also is permissible to refer to high select logic for pump control.

Basis 2

If student states assumption of both S/G's in HLO, then both pumps will go to minimum speed.

Comment 3

c. Change 91% to 87%.

Basis 3

Current plant HLO reset setpoint as per the Setpoint Document.

CATEGORY 6 (Continued)

6.03.b. Comment 1

Accept ~ 3900 RPM as alternate answer for FW pump speed.

Basis 1

Actual minimum speed value.

Comment 2

Change second sentence to read "The Startup (Bypass) Regulating Valve is held at the 5% Flow Demand position (~ 20 to ~ 24% open).

Basis 2

Design modification was implemented on the FWCS programs. Refer to Attachment 3.06a for overview of the Startup Regulating Valve program.

6.04.b. Comment

Delete first required response on answer key.

"As the CC temperature increases, the dry cooling tower fans sequence on."

Basis

Question does not solicit this response. The "other components/systems" are requested. The Dry Cooling Tower Fans are considered part of the Dry Cooling Towers requested in part a of this question.

6.05.b. Comment

Delete "by the caustic spray" on the answer key.

Basis

Question requested sources only. Actually spray is acidic until RAS occurs. Also corrosion of metals occurs due to the high temperature steam environment even if containment spray is terminated.

CATEGORY 6 (Continued)

6.09 Comment 1

Place parentheses around first sentence in answer key. "(Indicated pressurizer level indicates high.)"

Basis 1

This response is not solicited for describing plant response. In addition not all pressurizer level indications fail high.

Comment 2

Change "The letdown valves open fully" to read "The letdown valves open to maximum letdown (128 gpm)."

Basis 2

During automatic operation the maximum flowrate is limited. Refer to Pressurizer Pressure and Level Control System Description, page 7 Paragraph A.1.3.1.3.

Comment 3

CAF was requested on answer key concerning pressurizer heater response. "The heaters trip when the other level channel reaches 28% (if BOTH is selected on the Heater Cutout Selector Switch). However, no points are awarded for this statement anyway.

Basis 3

Refer to Pressurizer Pressure and Level Control System Description, pages 16 and 17 Paragraphs A.3.2.3.1 and A.3.2.3.2.

END OF CATEGORY 6

CATEGORY 7

7.02 Comment

Expand answer to include receipt of a CSAS (Containment Spray Actuation Signal) as one of the two possible required responses.

Basis

Due to new design modification, CCW is automatically secured to the RCP's on a CSAS. This requires immediate trip of the RCP's since CCW flow cannot be restored before exceeding 3 minutes. Refer to CCW System Lesson Plan (L124-009-00 Page 19) for design modification information. This modification and RCP Trip Criteria has been incorporated in the upcoming Revision of the FBEOP's. The candidates have been trained on these procedures in preparation for the anticipated implementation of the new revision.

7.04 Comment

Accept concept of being at or near saturation (as description of acceptable condition for operating the RCS solid).

Basis

Question did not solicit a specific numeric value. Moreover, the value cited in the answer key (i.e. < 28 degrees subcooled) is the standard value of subcooling used throughout the EOP set, below which the RCS should be considered at or near saturation (as per PV-OP-902, Parameter Values Document).

7.08 Comment

Accept concept and equivalent alternate descriptions of worsened core conditions in the vicinity of CEA finger tips.

Basis

Various terminology can be used to explain the phenomena asked about.

CATEGORY 7 (Continued)

7.10 Comment

Delete question from examination.

Basis

The level of knowledge required of senior licensed operators for this off-normal operating procedure does not include memorization of wind speed cutoff values and hail diameters for Severe Thunderstorm Warning conditions. Job analysis (including the ongoing effort at Waterford 3 in support of INPO accreditation) will support this conclusion. Additionally, memorization of the organizations supplying information on weather and flooding conditions is not functionally useful since the same note listing these organizations must be referred to in order to obtain the phone numbers at which they can be contacted.

7.12 Comment

Delete question from examination

Basis

Item does not appear in KSA Catalogue. The closest approach is Plant-Wide Generic K/A number 36 (page 2 - 3) stating:

"36. Ability to take actions called for in the Facility Emergency Plan, including (if required) supporting or acting as the Emergency Coordinator."

This requirement is much too general to support requiring memorization of time of administration effectiveness data for Potassium Iodide (KI).

Additionally, any reasonable accident scenario where use of the blocking agent may be appropriate will have progressed beyond the point where the Shift Supervisor will have been relieved as Emergency Coordinator (further supporting that this item is not appropriate for a licensed operator KSA item). For any case where blocking agents were actually to be administered, the procedure (see EP-2-033) requires a review of precautions and effectiveness information with personnel receiving doses (i.e. having this information memorized is not only not required but memory alone should not be relied upon).

7.13 Comment

Delete "Internal" from the phrase "Internal Alpha".

Basis

Alphas are normally considered an internal hazard, therefore, that specific term should not be required.

END OF CATEGORY 7

CATEGORY 8

8.01 Comment

Point value for last element of answer is not indicated. Should be 0.3 points.

Basis

Not applicable.

8.04 Comment

Accept alternate descriptions of area access keys such as "HP and/or Security controlled Room (Area) Keys."

Basis

These are common acceptable Waterford-3 descriptions.

8.05i. Comment

Change answer to "YES".

Basis

Technical Specifications Section 6.8.4(c) establishes requirement for a secondary water chemistry program which most definitely places limits on condensate storage pool chemistry.

8.05j. Comment

Change answer to "YES".

Basis

The Plant Monitoring Computer supports operation of COLSS, which if lost requires alternate methods of ensuring operation within various LCO's (e.g. DNBR, LPD, ASI, etc.). Refer to Attachment 8.05 from Technical Specifications.

CATEGORY 8 (Continued)

8.06f. Comment

Delete question part and answer from examination.

Basis

Insufficient information is given to assess condition. The LCO can be met by a secured unit which has no CCW flow (normally 3 of 4 CFC's running) provided it and the other 3 units are OPERABLE. Even with reference to Surveillance Requirements the value given (640 GPM) would be within acceptable limits for performing the 31 day test of operability (≥ 625 GPM) but would not be within acceptable limits if performing the 18 month test run for SIAS condition (≥ 1325 GPM).

8.07 Comment

Change item 3 on answer key to accept "LPD" or "Local Power Density" vice "Linear Power Distribution, LPD"

Basis

Procedure uses "LPD" specifically. The LPD acronym stands for Local Power Density.

8.08 Comment

Change answer to "YES".

Basis

Under the "Loss of RCS Inventory" tab of EP-1-001, item 3 would apply indicating an ALERT for the conditions given. Excerpt quoted below:

"3) Steam line break with significant (greater than 10 GPM) primary to secondary leak rate as indicated by:

Equilibrium charging flow minus total letdown flow greater than 10 GPM greater than known total RCS leakage.

AND

Uncontrolled decrease in S/G pressure(s) to MSIS as shown on SMA, SMB, SMC, SMD(CP-8) [MS-IPT-0301AS, (0301BS), (0303AS), (0303BS)]."

Since leakage rate is given as 12 GPM the first indication is met. The problem states that a "steam line fault" is present which implies secondary pressure decrease to the MSIS setpoint (per the diagnostics tree of OP-902-000, Emergency Entry Procedure).

CATEGORY 8 (Continued)

8.09b. Comment

Award full credit (1.0 points) for the first part of the answer (i.e. to the first 0.5 points).

Basis

That response adequately addresses the question as asked. The second part of the answer (addressing the normal practice of remaining in compliance if at all possible) was not asked for. (Note: it is recognized that the wording of paragraph 10CFR50.54(X) includes a phrase about the normal practice of remaining in compliance if possible. However, the question as asked was not identical with stating 10CFR50.54(X) verbatim.) Refer to Attachment 8.09b.

8.11 Comment

The use of the term "transient" in the context of OP-100-01, Duties and Responsibilities of Operators on Duty, can be legitimately interpreted more broadly than implied by the answer key to this question. Specifically, the numeric values used in UNT-7-011 (i.e. >10%, <1 minute, >100°F per hour, etc.) should not be required for a full credit in an OP-100-01 context.

Basis

The specific terms "reactor transient" and "secondary system transient" are not defined in OP-100-01 (which does have a list of formally defined terms) and do not even appear in OP-100-01 (yet the question set-up clearly was asking for meanings of these terms in the context of OP-100-01). The definitions of "reactor transient" and "secondary system transient" appearing in UNT-7-011, Duties and Responsibilities of the STA, are used there to formally identify when the STA must perform certain duties. These definitions do not necessarily carry over to other contexts and other types of procedures (UNT-7-011 is an Administrative Procedure whereas OP-100-01 is an Operating Procedure).

END OF CATEGORY 8