UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

ENCLOSURE 1

EXAMINATION REPORT - 50-269/OL-86-02

Facility Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Facility Name: Oconee Nuclear Station

Facility Docket Nos.: 50-269, 50-270 and 50-287

Written, simulator and oral examinations were administered at the Oconee Nuclear Station near Seneca, South Carolina.

Chief Examiner: Sandy Lawyer — 9/30/86 Date Signed

Approved by: for John F. Munro, Acting Section Chief — 11/4/86 Date Signed

Summary:

Examinations on July 14-17, 1986

Oral examinations were administered to twelve RO candidates; all of whom passed. Simulator examinations were administered to twelve RO candidates; all of whom passed. Written examinations were administered to twelve RO candidates; ten of whom passed. Oral examinations were administered to two SRO candidates; both of whom passed. Simulator examinations were administered to two SRO candidates; one of who passed. Based on the results described above, ten of twelve ROs passed and one of two SROs passed.

REPORT DETAILS

1. Facility Employees Contacted:

*P. Stovall, Plant Operations Instructor
*D. Tidwell, Instructor
*R. Bugert, Training Supervisor
*L. Hindman, Instructor
*J. Price, Assistant Shift Operating Engineer
*R. Yarbrough, Instructor
*T. Loflin, Instructor
*J. Byko, Instructor
*D. Sweigart, Superintendent of Operations

*Attended Exit Meeting

2. Examiners:

J. Huenefeld, PNL
B. Gore, PNL
*Sandy Lawyer, NRC

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examinations, the examiners provided Mr. Stovall with a copy of the written examination and answer key for review. The comments made by the facility reviewers are included as Enclosure 3 to this report, and the NRC resolutions to these comments are listed below. The comments made by the Facility Educational Specialist are not addressed, since they provide additional information for examination development only.

a. RO Exam

(1) Question 1.01b

NRC Resolution: The resultant negative startup rate would not be the same. The new reference provided in the comment assumes the introduction of a large negative reactivity. In the case of a small negative reactivity, as in 1.01b, the negative stable period is inversely proportional to the negative reactivity. (See Principles of Nuclear Reactor Engineering; Glasstone, Samuel, 1955, p. 238, paragraph 4.40). No change required.

(2) Question 1.02a

NRC Resolution: The suggested additional answer "just critical", if accompanied by the appropriate explanation, was accepted as per the original answer key. No change required.

(3) Question 1.04

NRC Resolution: The additional suggested answer is correct and is considered to be a subset of second effect given on the answer key, i.e., long time exposure effects and the necessary increase in thermal flux due to the decrease in excess reactivity over core life. The decrease in boron, also a long term effect, is also caused by the reduction in excess reactivity. Full credit was given for the facility's response. No change required.

(4) Question 1.06b

NRC Resolution: The additional answer, "more overmoderated" was considered to be a subset of the original answer key, and full credit was given for this answer. No change required.

(5) Question 1.09

NRC Resolution: The larger ΔT (Item 1) between primary and secondary is correct and was added to the answer key. Item 2 is correct and was graded accordingly, but is not substantially different than the answer key.

(6) Question 2.09

NRC Resolution: The answer key item 2 was changed to reflect that the problem crystallization can occur in either the piping between the letdown filters and the LDST or in the areas of close tolerances such as the RCP seals.

(7) Question 2.11

NRC Resolution: The answer key item 2 was changed to read "Reactor Coolant Pumps."

(8) Question 2.20

NRC Resolution: The word "mechanical" on the answer key was changed to "hydraulic."

(9) Question 2.23

NRC Resolution: The reference AP-22 states that if a loss of any major system function has occurred (letdown or turbine bypass) as a result of loss of IA, then manually trip the reactor. NUREG 1122 under EPE mode 065 "loss of instrument air" requires an RO to have the ability to determine or interpret when (at what pressure) to trip the reactor during degraded instrument air conditions. Memorization of a specific pressure was not intended. To reflect this, a band of + or - was specified on the answer key.

(10) Question 3.04

NRC Resolution: The suggested answer was added to the answer key.

(11) Question 3.07

NRC Resolution: The information provided was duly noted. Since it has no impact on the exam results, no change to the answer key was necessary. It is assumed the utility will correct the referenced training material prior to future use.

(12) Question 3.08

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

(13) Question 3.12

NRC Resoultion: The comment is correct. The answer key was changed accordingly.

(14) Question 3.16a

NRC Resolution: The comment was not accepted. The question specified "the two (2)" parameters that are monitored as opposed to any parameter related to the main feedwater pumps. No new material supporting the comment was provided. No change required.

(15) Question 3.17

NRC Resolution: Credit will be given if the candidates stipulate the assumption that they are making. No change required.

(16) Question 3.18b

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

(17) Question 3.20

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

(18) Question 4.02

NRC Resolution: All three answers combined constitute a complete answer to this question; however, the answer provided in the original answer key is considered to be most significant; therefore it is the only answer required for full credit. No change required.

(19) Question 4.03

NRC resolution: The comment is unclear. No change was proposed or made.

(20) Question 4.19

NRC Resolution: The comment is correct. The third answer was deleted and the point value changed accordingly.

4. Exit Meeting

At the conclusion of the site visit the examiners met with representatives of the plant staff to discuss the results of the examination.

There were no generic weaknesses noted during the oral examination.

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

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

Master Copy

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: OCONEE 1, 2&3

REACTOR TYPE: PWR-B&W177

DATE ADMINISTERED: 86/07/15

EXAMINER: HUENEFELD, J.

APPLICANT: ANSWER KEY

INSTRUCTIONS TO APPLICANT:

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

CATEGORY VALUE	% OF TOTAL	APPLICANT'S SCORE	% OF CATEGORY 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	100.00			TOTALS

FINAL GRADE _______________%

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

____
APPLICANT'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 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 parenthesis 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 a 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 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.

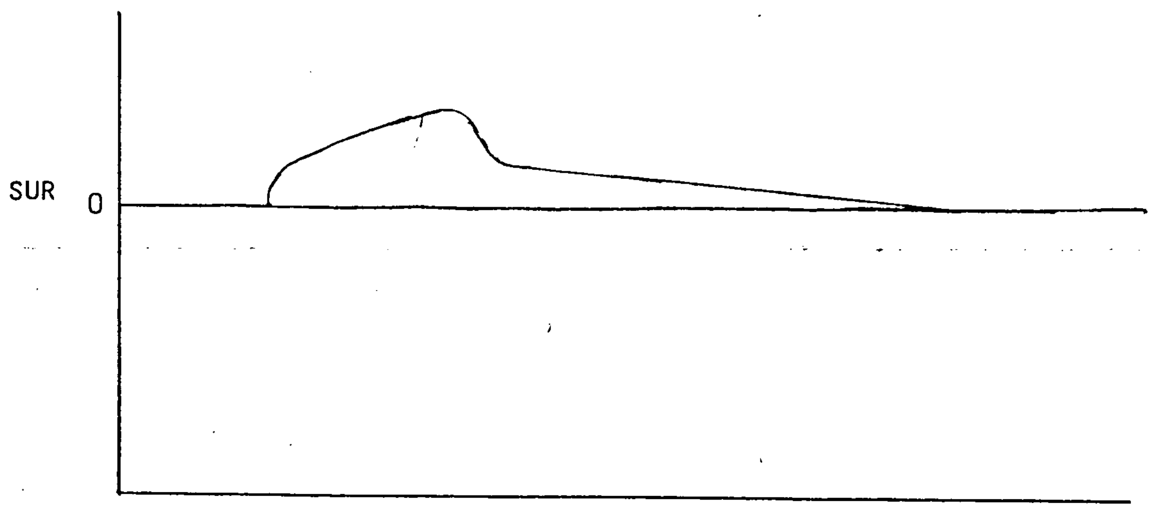
QUESTION 1.01 (3.00)

a. SKETCH a trace of logarithmic neutron countrate versus time following a reactor trip. LABEL the axes of your trace, and clearly SHOW the effects of prompt and delayed neutrons. (1.5)

b. A trip inserts a value of reactivity much greater than the value of Beta (Delayed Neutron Fraction). ON THE SAME SKETCH prepared for part a., SKETCH a trace of reactor power versus time for the case where the reactor is made to be subcritical by an amount much less than Beta. (1.5)

QUESTION 1.02 (3.00)

Below is a trace of startup rate (SUR) versus time before, during, and after a rod pull.



a. DOES this behavior of SUR indicate supercriticality, criticality, or subcriticality? EXPLAIN. (1.0)

b. EXPLAIN WHAT effect the presence of prompt and delayed neutrons have in determining the shape of this SUR curve. (1.0)

c. HOW would this SUR curve change if the same amount of reactivity was added, but at an increased rate? (1.0)

QUESTION 1.03 (1.00)

A reactor is supercritical with a constant positive startup rate (SUR) of one (1) decade per minute. Negative reactivity is rapidly inserted until SUR equals 0.5 decade per minute, at which time the reactivity change is terminated. WHAT does SUR do after the reactivity change is terminated, and WHY? (1.0)

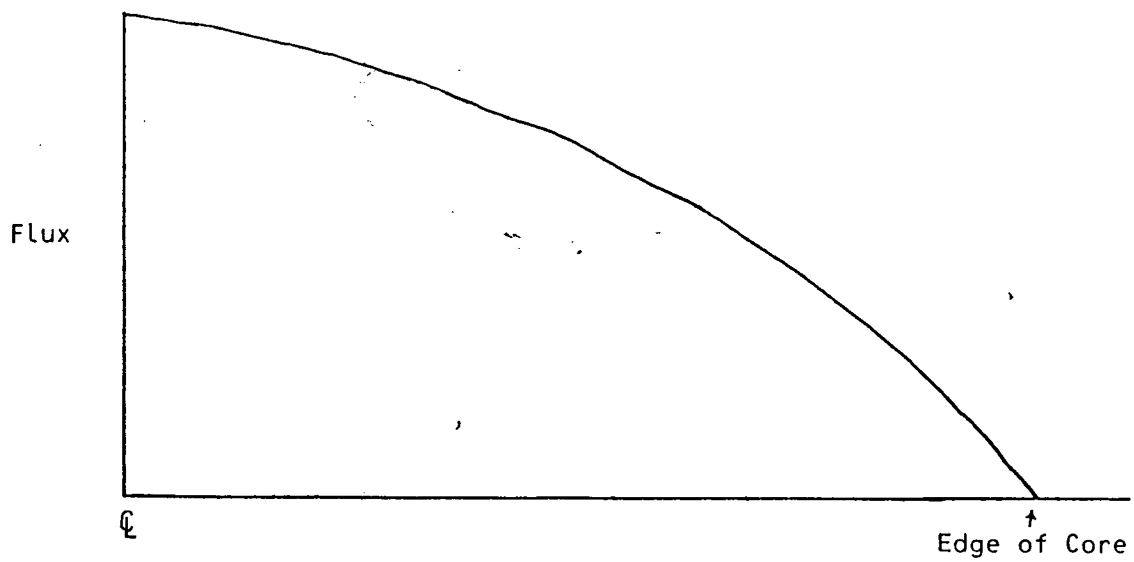
QUESTION 1.04 (2.00)

Total xenon worth over core life increases for two (2) reasons. WHAT are those two (2) reasons? (2.0)

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

QUESTION 1.05 (2.50)

Below is a simplified graph of the ~~axial~~ radial flux profile across one half of a symmetrical reactor.



a. Assuming that a rod has been fully inserted at a position corresponding to the centerline of the reactor, on your answer sheet SKETCH the resultant effect that the rod has on the flux shape. (1.5)

b. HOW does the insertion of the rod near the center of the core affect the reactivity of a different rod near the edge of the core? EXPLAIN. (1.0)

QUESTION 1.06 (1.50)

a. EXPLAIN the terms UNDERMODERATED and OVERMODERATED. (1.0)

b. DOES the addition of boron to the reactor coolant tend to make the reactor MORE or LESS undermoderated OR overmoderated? (0.5)

QUESTION 1.07 (2.00)

With the RCS at normal operating temperature and pressure, HOW MUCH would compensated pressurizer level increase if ten (10) inches of letdown storage tank (LDST) level were injected into the RCS (i.e., makeup and letdown are manually adjusted to stabilize LDST level ten (10) inches below its previous level)? (Steam tables have been included for determining temperature density effects.) (2.0)

QUESTION 1.08 (1.50)

For WHAT thermodynamic reason should a nitrogen bubble NOT be maintained in the pressurizer during power operation? (1.5)

QUESTION 1.09 (2.00)

STATE two (2) reasons WHY using the emergency feedwater nozzles in OTSGs results in more effective transfer of heat from the primary to the secondary. (2.0)

QUESTION 1.10 (2.50)

HOW and WHY is RCS flow rate affected by temperature during a reactor coolant system heatup? (ASSUME no change in the number of RCPs running to answer this question. Your discussion should include a description of the effect of temperature on pump head, head loss, pump power, volumetric flowrate and mass flowrate.) (2.5)

QUESTION 1.11 (1.00)

The amount of N16 that decays between the reactor core and the RCP outlet during normal power operation is about: (1.0)

(a.) 99%
(b.) 50%
(c.) 10%
(d.) 1%

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

QUESTION 1.12 (1.00)

A control rod is stuck in the core at the 25% rod index position (3/4 of the rod is inserted into the core). This position corresponds to WHAT percent of the NEGATIVE reactivity available for that rod? (SELECT one.) (1.0)

(a.) 33%
(b.) 54%
(c.) 73%
(d.) 99%

QUESTION 1.13 (1.00)

a. WHAT is the thumbrule value for total rod worth? (0.5)

b. WHAT is the thumbrule value for safety groups only? (0.5)

QUESTION 1.14 (1.00)

WHICH of the following parameters when considered along with pump motor current and voltage would be most useful to determine the enthalpy rise across an operating RCP? (SELECT one) (1.0)

(a.) flowrate
(b.) delta P
(c.) delta T
(d.) RPM

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

QUESTION 2.01 (1.50)

WHAT is the difference between the resin used in the normal purification demineralizer and that used in the spare purification demineralizer? WHY is this difference necessary? (1.5)

QUESTION 2.02 (1.50)

Besides impacting chemistry control, WHY is having too much hydrogen pressure in the LDST an un-safe practice? (1.5)

QUESTION 2.03 (1.00)

WHY is it necessary to be able to bypass the Number One seal on the Unit 1 Reactor Coolant Pumps? (1.0)

QUESTION 2.04 (1.00)

The seal return valves for the Unit 2 and Unit 3 RCPs are interlocked to close in the event that seal injection is lost and the RCP is off. WHAT is the reason for this interlock? (1.0)

QUESTION 2.05 (1.00)

WHAT component cools the minimum recirculation flow (35 gpm) from the HPI pumps? (1.0)

QUESTION 2.06 (1.00)

CAN the HPI header cross-connect valves be used to throttle flow? EXPLAIN. (1.0)

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

QUESTION 2.07 (1.00)

WHICH of the following are LOST as a result of a loss of instrument air? (SELECT one OR more.) (1.0)

(a.) letdown
(b.) RCP seal return
(c.) makeup to RCS
(d.) RCP seal injection

QUESTION 2.08 (2.00)

Thermal sleeves are installed in various Reactor Coolant System nozzles where required to limit thermal stresses. The four (4) high pressure injection nozzles on the reactor inlet pipes are an example. GIVE two (2) other separate examples of instances where thermal sleeves are installed. (2.0)

QUESTION 2.09 (1.00)

WHAT would be the problem associated with adding 9000 ppm boric acid to the LDST with no letdown flow established. (1.0)

QUESTION 2.10 (1.00)

WHAT are two (2) purposes for the bypass flowpath around the pressurizer spray control valve? (1.0)

QUESTION 2.11 (1.00)

LIST all four (4) of the loads serviced by the Component Cooling System. (1.0)

QUESTION 2.12 (.50)

WHICH cooling water system cools the Reactor Coolant Pump motor bearings? (0.5)

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

QUESTION 2.13 (1.00)

The Reactor Coolant Pump flywheel stores momentum and thus ensures that the length of time for pump coast down is at least: (SELECT one.) (1.0)

(a.) 10 to 20 seconds
(b.) 1 to 2 minutes
(c.) 5 to 10 minutes
(d.) > 20 minutes

QUESTION 2.14 (2.00)

GIVE two (2) purposes for ensuring that the RCPs do not rotate in the reverse direction. (2.0)

QUESTION 2.15 (1.00)

For the Bingham style RCPs (Units 2 and 3) a failure of WHICH seal would be accompanied by a DECREASE in seal return flow? (1.0)

QUESTION 2.16 (1.00)

WHY can no more than two (2) RBCUs be run in high speed? (1.0)

QUESTION 2.17 (1.00)

The Reactor Building Cooling system has two (2) design features that help to ensure operability during an accident by compensating for or preventing damage to duct work. STATE these two (2) design features. (1.0)

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

QUESTION 2.18 (1.00)

WHICH of the following best describes the effect that actuation of the reactor building spray system has upon containment hydrogen concentration? (SELECT one.) (1.0)

(a.) Increases because of radiolytic decomposition of water.

(b.) Increases because of a chemical reaction between boric acid and galvanized steel.

(c.) Decreases because of the "scrubbing" action of the water droplets.

(d.) Decreases because of the increase in containment humidity.

QUESTION 2.19 (1.00)

One or more of Control Rod Drive Mechanism thermal barrier ball checkvalves stick shut during a reactor trip. WHAT is the resultant effect on the Control Rod upon a reactor trip? (1.0)

QUESTION 2.20 (1.00)

WHY is improper venting a potentially damaging situation for a control rod drive mechanism? (1.0)

QUESTION 2.21 (.50)

WHICH has the greater volume when at power, the reactor coolant inlet piping OR the reactor coolant outlet piping? (0.5)

QUESTION 2.22 (1.00)

WHICH RCP supplies PZR spray for Unit 1? (1.0)

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

QUESTION 2.23 (1.00)

At WHAT air pressure and to WHAT position do the following valves fail during a loss of instrument air?

a. HP-5 (letdown valve) (0.5)
b. Turbine bypass valve (0.5)

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

QUESTION 3.01 (1.00)

An interlock at 18 inches LDST level is provided to return HP-14 to the "NORMAL" position if it is in the "BLEED" position. WHY is this interlock necessary? (1.0)

QUESTION 3.02 (1.00)

The Range Selector Switch on the Foxboro makeup controllers should be left on "1" for Units 1 and 3 and "100" for Unit 2. WHY is this desirable? (1.0)

QUESTION 3.03 (.50)

ANSWER TRUE or FALSE.

Resetting of the Engineered Safeguards stops the running HPI pumps. (0.5)

QUESTION 3.04 (1.50)

STATE three (3) of the six (6) interlocks associated with the component cooling water system. (Setpoints not required.) (1.5)

QUESTION 3.05 (.50)

ANSWER TRUE or FALSE.

Control rods will automatically de-energize upon loss of component cooling water flow. (0.5)

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

QUESTION 3.06 (1.50)

a. WHAT prevents inadvertently leaving a lift oil pump running during Reactor Coolant Pump operation? (0.5)

b. WHY is it detrimental to run a lift pump continuously for an extended time? (1.0)

QUESTION 3.07 (1.50)

STATE five (5) of the nine (9) interlocks associated with starting one of the Westinghouse RCPs (Unit 1). (Setpoints not required.) (1.5)

QUESTION 3.08 (1.50)

LIST the events that occur when ESG channels 5 and 6 actuate upon 4 psig RB pressure. (1.5)

QUESTION 3.09 (1.00)

Unit 1 has tripped on variable low pressure. The unit followed a normal post trip response with Tave about 547 deg F and pressure returning to approximately 2100 lbs. When the operator goes to reset the press/temp trip bistable in each RPS channel WHICH of the following light combinations should the operator see? (SELECT one.) (1.0)

(a.) Output state light bright
Memory state light bright

(b.) Output state light dim
Memory state light dim

(c.) Output state light bright
Memory state light dim

(d.) Output state light dim
Memory state light bright

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

QUESTION 3.10 (1.50)

LIST the controls available at the auxiliary shutdown panel. (1.5)

QUESTION 3.11 (1.00)

WHAT sensors provide temperature input to the Core Saturation Margin Program? (1.0)

QUESTION 3.12 (1.00)

The ICS uses the RCS hot leg temperature as input to WHAT two (2) circuits? (1.0)

QUESTION 3.13 (.50)

Above WHAT intermediate range power level would compensation no longer be necessary for accurate NI indication? (0.5)

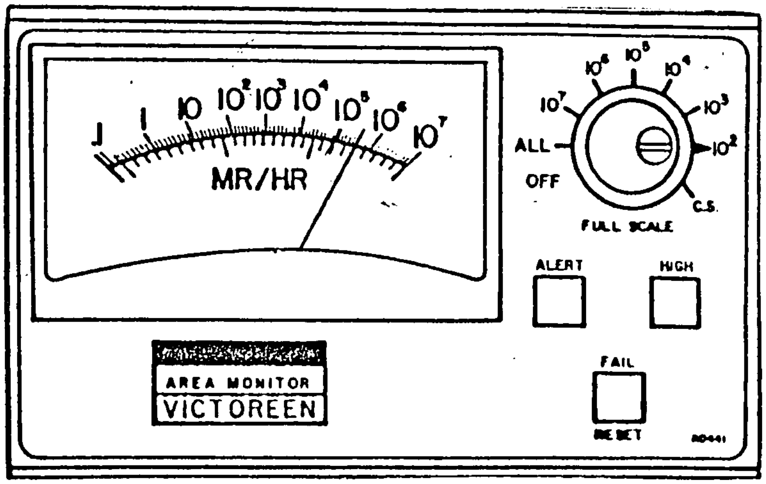
QUESTION 3.14 (1.00)

WHAT behavior characteristics of the incore instrumentation system makes it unsuitable for reactor protection? (1.0)

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

QUESTION 3.15 (1.00)

The reading on RIA-4 shown below (Reactor Building RIA) is
______________. (1.0)



QUESTION 3.16 (1.50)

a. LIST the two (2) parameters that are monitored to determine whether or not MFWPTs have tripped. (1.0)

b. ANSWER TRUE or FALSE.

Emergency Feedwater Control valves FDW-315 and 316 are modulated by separate control air signals, each of which is independent of the ICS. (0.5)

QUESTION 3.17 (.50)

ANSWER TRUE or FALSE.

If power from KVIA to RPS channel "A" is interrupted, the "A" A/C CRD breaker will trip even if the channel has been placed in channel bypass. (0.5)

QUESTION 3.18 (1.50)

Shutdown bypass is a function incorporated into all four (4) RPS cabinets.

a. WHAT four (4) trips are bypassed by the shutdown bypass switch? (1.0)

b. WHAT new limits, automatic and administrative, are imposed when going to shutdown bypass? (IDENTIFY which are automatic and which are administrative.) (0.5)

QUESTION 3.19 (.50)

ANSWER TRUE or FALSE.

The manual transfer switch performs an automatic fast acting make before-break transfer between the inverter and its parallel regulated power supply to ensure that its vital bus remains energized. (0.5)

QUESTION 3.20 (1.00)

WHAT is indicated if the Sync Verification Indicator lamp stays on continuously but at half brightness? (1.0)

QUESTION 3.21 (2.00)

STATE the actual trip setpoints for the following Engineered Safety Features. (2.0)

a. High Pressure Injection
b. Low Pressure Injection
c. Reactor Building Isolation
d. Reactor Building Spray

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

QUESTION 3.22 (.50)

ANSWER TRUE or FALSE.

Loss of power to any of the ES analog channels results in the trip that is normally associated with that channel, with the exception of the Reactor Building spray system. (0.5)

QUESTION 3.23 (1.50)

LIST three (3) of the four (4) signals which are used to derive the BTU limit in the Integrated Control System, and INDICATE whether increasing power raises or lowers the BTU limits for each signal. (1.5)

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

QUESTION 4.01 (1.00)

Exposure to radioactive xenon and krypton is considered to be: (SELECT one.) (1.0)

(a.) an internal dose only
(b.) an extremity dose only
(c.) a whole body dose
(d.) a surface contamination problem

QUESTION 4.02 (1.50)

With two (2) Reactor Building Cooling Units on in high speed, the third unit should be placed in "stop." WHY is this necessary? (1.5)

QUESTION 4.03 (2.00)

STATE two (2) conditions that require at least one (1) train of reactor building spray to be operable. (2.0)

QUESTION 4.04 (1.00)

The maximum run time per precautions and limitations for an LPI pump at shut-off head (no indicated flow) is: (SELECT one.) (1.0)

(a.) 30 seconds
(b.) 30 minutes
(c.) 60 seconds
(d.) 60 minutes

QUESTION 4.05 (2.00)

DEFINE shutdown margin. Carefully DISTINGUISH between the meaning as it applies to a critical and a subcritical reactor. (2.0)

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

QUESTION 4.06 (1.50)

Other than performing a reactivity balance, during startup and power operation HOW is shutdown margin known to be within limits? (1.5)

QUESTION 4.07 (1.00)

Reactor power is 10 E-6 amps in the intermediate range (approximately 1% power), the operating main FDW pump trips and all emergency FDW pumps start. WHICH of the following is the expected response? (SELECT one.) (1.0)

(a.) The reactor trips on high pressure.
(b.) The reactor trips on loss of both FDW pumps anticipatory trip.
(c.) No action, only one pump tripped.
(d.) The operator manually trips the reactor.

QUESTION 4.08 (2.00)

LIST the five (5) automatic actions that should occur for a reactor trip. (2.0)

QUESTION 4.09 (1.50)

Subcooling margin is lost due to a LOCA. STATE three (3) actions that must be taken or initiated immediately, per your emergency procedure, to ensure adequate core cooling. (1.5)

QUESTION 4.10 (1.50)

If there is no Operating Range of steam generator level available, HOW can XSUR level be used to estimate Operating Range level? (1.5)

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

QUESTION 4.11 (1.00)

If after a reactor trip PZR level cannot be maintained >100" with normal makeup, WHAT must be done with HPI? (1.0)

QUESTION 4.12 (1.00)

GIVE four (4) indications that primary to secondary heat transfer is NOT adequate. (1.0)

QUESTION 4.13 (2.00)

a. Under WHAT combination of two (2) conditions must HPI cooling be initiated? (1.0)

b. WHAT actions must be taken to establish HPI cooling? (Two (2) actions required for full credit.) (1.0)

QUESTION 4.14 (.50)

ANSWER TRUE or FALSE.

Feeding the OTSG's with Auxiliary Service Water is preferable to establishing HPI cooling. (0.5)

QUESTION 4.15 (1.00)

WHAT is meant by the term "bump" a Reactor Coolant pump? (Be specific.) (1.0)

QUESTION 4.16 (1.00)

WHY is BWST level a special concern during a large OTSG tube leak? (1.0)

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

QUESTION 4.17 (1.00)

WHAT is the maximum allowable flow in EACH LPI header during a cooldown following a large LOCA? (1.0)

QUESTION 4.18 (1.00)

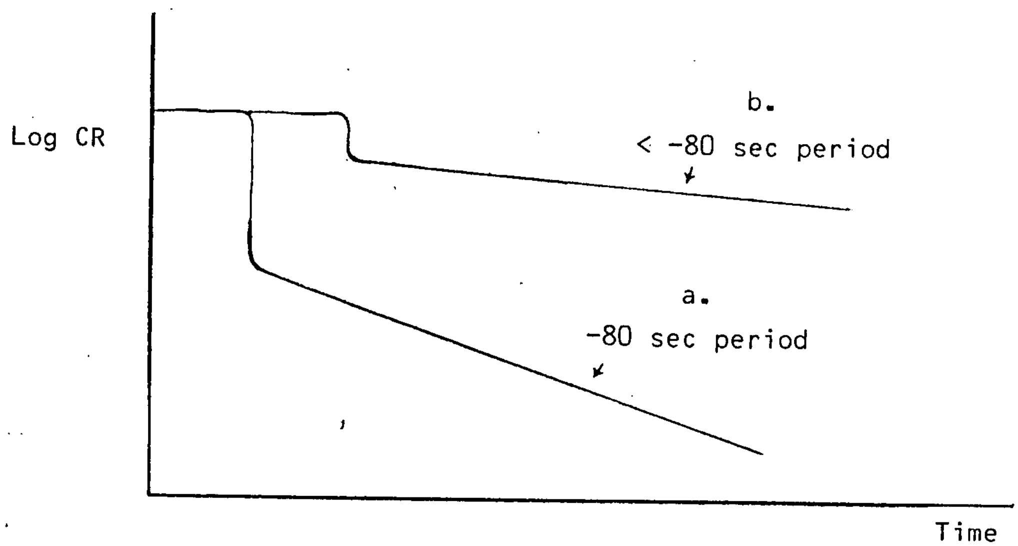
WHAT is the maximum allowable flow for one (1) HPI pump? (1.0)

QUESTION 4.19 (1.50)

Under WHAT circumstances may HPI be throttled once it has been initiated? (1.5)

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

ANSWER 1.01 (3.00)



REFERENCE

1. Oconee: Fundamentals of Nuclear Reactor Engineering, pp. 97 and 105.

ANSWER 1.02 (3.00)

a. Because SUR decays to zero, the reactor is subcritical. (If the reactor was critical with a source present, SUR would approach zero asymptotically. If the reactor was supercritical, SUR would level off at a positive value.) [+1.0]

b. Prompt neutrons respond rapidly to reactivity change. While reactivity is being added, SUR will increase. When the reactivity insertion is stopped, the influence of prompt neutrons and short lived delayed precursors rapidly die off, leaving the effect of the longest lived delayed neutrons. [+1.0]

c. The prompt effect would be enhanced (i.e., a greater SUR would be achieved in a shorter period of time), however, the effect of the delayed neutrons would not be affected (i.e., the post reactivity insertion "tail" would look the same). [+1.0]

REFERENCE

1. Oconee: Subcritical Multiplication Lesson Plan.

ANSWER 1.03 (1.00)

SUR will increase slightly because of the effect of delayed neutrons. (After the reactivity insertion is terminated, the effect on prompt neutrons rapidly dies off. Delayed neutrons will not be in equilibrium for several minutes after the reactivity insertion. SUR will increase slightly due to the effect of the delayed neutrons not being in equilibrium with the reactivity change.) [+1.0]

REFERENCE

1. Oconee: Fundamentals of Nuclear Reactor Engineering, p. 95.

ANSWER 1.04 (2.00)

1. The overall fission yield increases because of the increase in fissions due to Pu-239. (Furthermore, the increase in fission yield is sufficient to overcome the effect of increase in burnup caused by the next factor.) [+1.0]

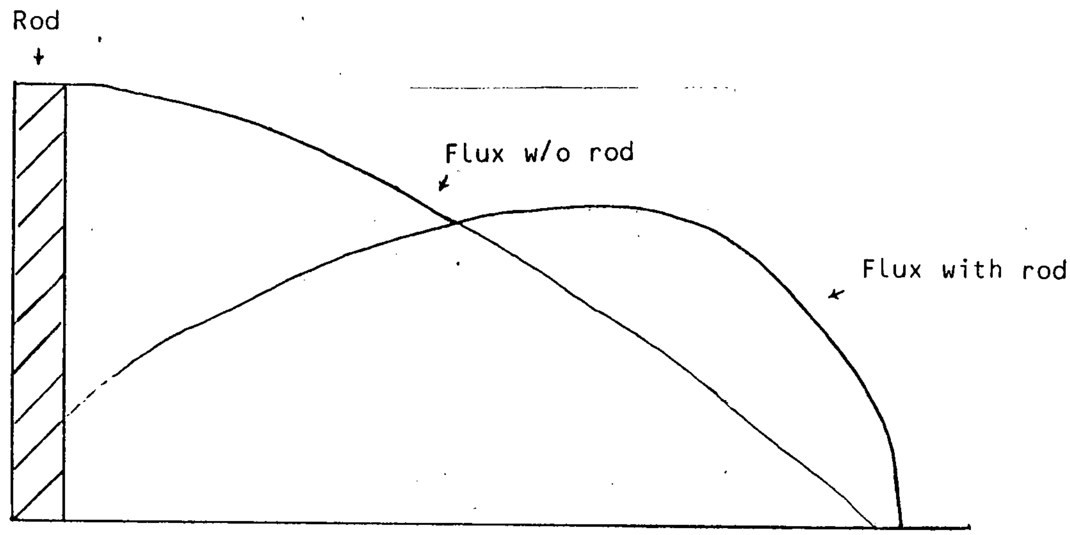
2. Because the fissionable fuel density decreases over core life, an increase in thermal flux becomes necessary to sustain maximum thermal power. This increased flux results in an increase in reactivity of xenon. (The increased burnout due to the higher thermal flux is not high enough to overcome the effect of the increase in fission yield discussed above until an atom % burnout of about 10% is reached.) [+1.0]

REFERENCE

1. Oconee: Fundamentals of Nuclear Reactor Engineering, p. 168.

ANSWER 1.05 (2.50)

a.



b. A rod near the edge of the core would be worth more after insertion of the rod. This is because the flux distribution is shifted toward the outer regions of the core by the inserted rod. [+1.0]

REFERENCE

1. Oconee: Fundamentals of Nuclear Reactor Engineering, p. 140.

ANSWER 1.06 (1.50)

a. A reactor is undermoderated if the moderator to fuel ratio is less than optimum. In this case, reducing moderation (by heating up and reducing water density) inserts negative reactivity. Overmoderated is the opposite, and heating up inserts positive reactivity. [+1.0]

b. The addition of boron tends to make the reactor less undermoderated. [+0.5]

REFERENCE

1. Oconee: Fundamentals of Nuclear Reactor Engineering, p. 153.

ANSWER 1.07 (2.00)

31.3 gal/inches in the LDST [+0.6]

23.99 gal/inches in the PZR [+0.6]

Density ratio, cold to hot = 1.6 [+0.5]

(31.3 gal per inches)(10 inches)(1.6)/(23.99 gal per inches) = 20.9 inches [+0.3]

REFERENCE

1. Generic: B&W Systems Book, p. RCS 12.

2. Oconee: OP-OC-SPS-SY-HPI, p. 19 of 43.

ANSWER 1.08 (1.50)

Having nitrogen in the pressurizer would eliminate the natural advantages associated with having a saturated system for controlling pressure during an in-surge. Because the bubble in the PZR is normally steam, it may be rapidly de-superheated and condensed with spray. Nitrogen would not be condensed by spray, and would therefore be of less use in mitigating a pressure rise during an in-surge. [+1.5]

REFERENCE

1. Oconee: OP-OC-SPS-CM-PZR, p. 18 of 22.

ANSWER 1.09 (2.00)

1. The EFW flowpath increases the effective area for heat transfer in the OTSG. [+1.0]

2. The EFW flowpath results in a reduction in saturation pressure, and therefore temperature, in the OTSG. [+1.0]

3. Lower temperature of the CST water provides greater delta T.

REFERENCE

1. Generic: The B&W Abnormal Transient Operator Guidelines Technical Bases Document.

ANSWER 1.10 (2.50)

Head versus volumetric flowrate for a pump is constant, regardless of fluid density. The system curve and the power-required curve both pivot clockwise (down) with increasing temperature. This is because as the RCS heats up, the viscosity of the water decreases, and therefore the system headloss decreases. The power required tends to decrease because the density of each cubic foot pumped decreases. The net result is an increase in volumetric flowrate of a few percent. The density change is more dramatic and overrides the change in volumetric flowrate. This causes mass flowrate to decrease with increasing temperature. [+2.5]

REFERENCE

1. Generic: Centrifugal Pumps and System Hydraulics, Igor Karrassik.

2. Oconee: Thermodynamics and Fluid Flow.

ANSWER 1.11 (1.00)

(b.) [+1.0]

REFERENCE

1. Oconee: OC-SPS-RPT-10 (Figure).

ANSWER 1.12 (1.00)

(d.) [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CRD, p. 7 of 14.

ANSWER 1.13 (1.00)

a. 9% delta k/k [+0.5]
b. 6% delta k/k [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-RT-IP, p. 20 of 30.

ANSWER 1.14 (1.00)

(a.) [+1.0]

REFERENCE

1. Oconee: Thermodynamics of Pumps.

ANSWER 2.01 (1.50)

The resin in the spare purification demineralizer is not lithium saturated. [+0.5]

This is to provide a means for lithium removal during operation since lithium can be produced by activation of boron in a neutron flux. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 16 of 43.

ANSWER 2.02 (1.50)

Too much hydrogen pressure in the LDST could cause the LDST to empty prior to being overcome by the BWST gravity head. This could result in allowing gas to enter the suction of the HPI pumps, thus leading to pump failure. [+1.5]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 19 of 43.

ANSWER 2.03 (1.00)

It can be opened to provide cooling flow past the radial bearing of the Unit 1 reactor coolant pumps. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 23 of 43.

ANSWER 2.04 (1.00)

With the RCP stopped, there is no longer any driving force from the auxiliary impeller to force cooling flow through the seal cooling heat exchanger. If seal return were not stopped, hot RCS water could flow up the shaft of the pump and through the seal staging devices, therefore, over-heating the seals. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 23 of 43.

ANSWER 2.05 (1.00)

The seal return coolers. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI.

ANSWER 2.06 (1.00)

Yes. However, the valves are gate valves so it should be avoided if possible. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 28 of 43.

ANSWER 2.07 (1.00)

(a.), (b.), and (c.) [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 29 of 43.

ANSWER 2.08 (2.00)

1. The two (2) core flood low pressure injection nozzles on the reactor vessel.

2. The surge line nozzle on the PZR.

3. The spray line nozzle on the PZR.

Any two (2) for [+1.0] each, +2.0 maximum.

REFERENCE

1. Oconee: OP-OC-SPS-SY-RGS, p. 14 of 24.

ANSWER 2.09 (1.00)

Crystalization can occur in either the piping between the
~~The piping down to the LDST is not heat traced. This provides the potential for boron crystallization in the makeup piping.~~ [+1.0]
letdown filters and the LDST or in the areas of close tolerances such as the RCP seals.

REFERENCE

1. Oconee: OP-OC-SPS-SY-RCS, p. 20 of 24.

ANSWER 2.10 (1.00)

1. To minimize cooldown of the coolant in the spray and surge lines. [+0.5]

2. To eliminate abnormal buildup or dilution of boric acid within the pressurizer. [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-CM-PZR, p. 12 of 22.

ANSWER 2.11 (1.00)

1. Letdown coolers
2. Reactor coolant pumps ~~cooling jackets and seal coolers~~
3. Quench tank cooler
4. Control rod drive cooling coils

[+0.25] each

REFERENCE

1. Oconee: OP-OC-SPS-SY-CC, p. 9 of 20.

ANSWER 2.12 (.50)

The Low Pressure Service Water System [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CPM, p. 9 of 18.

ANSWER 2.13 (1.00)

(b.) [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CPM, p. 11 of 18.

ANSWER 2.14 (2.00)

1. to minimize core bypass flow when <4 RCPs are running
2. to prevent the excessive current which would result if the pump were started by spinning in reverse
3. to prevent motor bearing damage due to improper lubrication since the pump is not designed to spin in reverse and lubricate the bearings properly
4. to reduce the leakage backwards through the RC Pump assuming a small break on the suction of the RC Pump. (If the pump were allowed to spin in reverse, it would simply spin and pump more water out the break.)

Any two (2) for [+1.0] each.

REFERENCE

1. Oconee: OP-OC-SPS-CM-CPM, p. 11 of 18.

ANSWER 2.15 (1.00)

Failure of the upper seal (no 3 seal). [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CPS, p. 32 of 41.

ANSWER 2.16 (1.00)

Backflow on the idle fan causes it to rotate backwards. If it is started, excessive starting torque will cause it to trip off on over-current. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-RBC, p. 17 of 30.

ANSWER 2.17 (1.00)

1. fusible dropout plates [+0.5]
2. blowout plates [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-SY-RBC, p. 11 of 30.

ANSWER 2.18 (1.00)

(b.) [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-BS, p. 10 of 18.

ANSWER 2.19 (1.00)

The rod drop time will be significantly lengthened (slowed). [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CRD.

ANSWER 2.20 (1.00)

Improper venting of a CRDM could result in a loss of the ~~mechanical~~ hydraulic buffer which may cause damage to the lead screw and/or control rod. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CRD, p. 12 of 14.

ANSWER 2.21 (.50)

The reactor coolant inlet piping. [+0.5]

REFERENCE

1. Oconee: PNS-RCS-RO-4d, QB.

ANSWER 2.22 (1.00)

1A1 [+1.0]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 10 of 147.

ANSWER 2.23 (1.00)

+10 -35

a. 70 psig (decreasing) - closed [+0.5]
b. 70 psig (decreasing) - closed [+0.5]

+10 -35

REFERENCE

1. Oconee: AP/1/A/1700/22, Enclosure 6.1.

ANSWERS -- OCONEE 1, 2&3 -86/07/15-HUENEFELD, J.

ANSWER 3.01 (1.00)

To ensure adequate suction to the HPI pumps. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 19 of 43.

ANSWER 3.02 (1.00)

Batch sizes will then be equivalent to gallons. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 21 of 43.

ANSWER 3.03 (.50)

FALSE. [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-SY-HPI, p. 27 of 43.

ANSWER 3.04 (1.50)

1. Standby CC pump starts at 575 gpm flow.
2. CRDs cannot be energized if CC flow is less than 138 gpm to CRDs.
3. RC pumps cannot be started if CC flow is less than 575 gpm.
4. CC1 must be open before HP1 will open.
5. CC2 must be open before HP2 will open.
6. CC7 and 8 close on actuation of ES channels 5 and 6.
7. If CC7 or CC8 is closed then the CC pumps may not be started or will trip.

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

REFERENCE

1. Oconee: OP-OC-SPS-SY-CC.

ANSWER 3.05 (.50)

FALSE. [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-SY-CC.

ANSWER 3.06 (1.50)

a. A three (3) minute timer automatically stops the AC and DC pumps. [+0.5]

b. The oil tends to break down and become scorched if run continuously for an extended time. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-CM-CPM, p. 10 of 18.

ANSWER 3.07 (1.50)

1. upper oil pot level not low
2. lower oil pot level not low
3. seal injection flow >= 22 gpm
4. component cooling flow (system flow) >= 575 gpm
5. #1 seal delta P >= 275 psid
6. reactor power < 50% f.p.
7. oil lift pump pressure >= 600 psig
8. oil lift pump running
9. Tc > 430 deg F to start fourth pump.

Any five (5) for [+0.3] each.

REFERENCE

1. Oconee: OP-OC-SPS-CM-CPS, p. 21 of 41.

ANSWER 3.08 (1.50)

The three LPSW outlet valves on the RBCU's go fully open. [+0.5]

LPSW is isolated to the RB aux fans and full LPSW flow is supplied to the B RBCU. [+0.5]

The standby RBCU automatically starts and runs in low speed while the two running units automatically swap to low speed. [+0.5]

Candidates may, but are not required to include Penetration Room ventilation fans starting and Essential Reactor Building Isolation.

REFERENCE

1. Oconee: OP-OC-SPS-SY-RBC, p. 19 of 30.

ANSWER 3.09 (1.00)

(a.) [+1.0]

REFERENCE

1. Oconee: IC-RPS-RO-1c.

ANSWER 3.10 (1.50)

1. Startup Feedwater Valve Hand/Auto Station (SG. A&B)
2. Turbine Bypass Valve Hand/Auto Station (A&B)
3. Pressurizer Level Control (HP-120 control)
4. Group 2 Pressurizer Heaters Control
5. "B" HPI Pump Control (with Remote/Local Selector Switch)
6. Selector Switch to power Turbine Bypass Valves from KI or KU

[+0.25] each

REFERENCE

1. Oconee: IC-ASP-RO-1d, QB.

ANSWER 3.11 (1.00)

The average of the 5 highest of the 24 qualified incore thermocouples. [+1.0]

REFERENCE

1. Oconee: IC-RCI-RD-1p, QB.

ANSWER 3.12 (1.00)

1. the BTU limit circuit [+0.5]
2. the RC flow temperature compensation circuit [+0.5]
3. ICS Tave circuit. (~~[illegible]~~ as a substitution for one of the above).

REFERENCE

1. Oconee: IC-RCI-RO-1d8, QB.

2. Oconee: IC-RCI-RO-1c3.

ANSWER 3.13 (.50)

10 E-9 amps [+0.5]

REFERENCE

1. Oconee: IC-NI-RO-1, QB IC.

ANSWER 3.14 (1.00)

The incore instrumentation system is very slow in responding to changes in neutron power. [+1.0]

REFERENCE

1. Oconee: IC-ICI-RO-1g, QB.

ANSWER 3.15 (1.00)

50 mr/hr [+1.0]

REFERENCE

1. Oconee: BPS-BP-RO-2b, QB.

ANSWER 3.16 (1.50)

a. Both MFWPTs have: 1) low hydraulic oil pressure (<75 psig) [+0.5] and 2) low discharge pressure (<750 psig) [+0.5].

b. TRUE. [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-SY-EF, pp. 41 and 42 of 71.

ANSWER 3.17 (.50)

TRUE. [+0.5]

REFERENCE

1. Oconee: IC-RPS-RO-1j, QB.

ANSWER 3.18 (1.50)

a. 1. Power/flow imbalance [+0.25]
   2. Power/pump [+0.25]
   3. Low pressure [+0.25]
   4. Variable low pressure [+0.25]

b. Automatic: new high pressure trip of 1720 [+0.25]

   Administrative: nuclear over power trip setpoint reduced to <= 5% (~~4.75%~~) of rated power during reactor shutdown [+0.25]
   4.00

REFERENCE

1. Oconee: IC-RPS-RO-1e, QB.

ANSWER 3.19 (.50)

FALSE. [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-EL-VPS, pp. 11 of 26.

ANSWER 3.20 (1.00)

This is an indication that ~~if the inverter voltage is normal, the AC line voltage is low.~~ there is a mismatch between AC line and inverter output voltage. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-EL-VPS, p. 13 of 26.

ANSWER 3.21 (2.00)

a. 1600 (psig RCS), 3 (psig RB) [+0.5]
b. 550 (psig RCS), 3 (psig RB) [+0.5]
c. 3 (psig RB) [+0.5]
d. 10 (psig RB) [+0.5]

REFERENCE

1. Oconee: OP-OC-SPS-IC-ES, p. 7 of 26.

ANSWER 3.22 (.50)

TRUE. [+0.5]

REFERENCE

1. DUKE: Engineered Safeguards training material, p. 3.

ANSWER 3.23 (1.50)

1. Th increases, therefore, increasing BTU limit.
2. S/G pressure increases, therefore, lowering BTU limit.
3. RC flow, remains the same.
4. FDW temperature increases, therefore, increasing BTU limit.

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

REFERENCE

1. DUKE: ICS training material.

ANSWER 4.01 (1.00)

(c.) [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-RAD-RPT, p. 24 of 51.

ANSWER 4.02 (1.50)

Under certain conditions a RBCU left in "auto" could start and run in "high" speed upon ES actuation. Due to high humidity and denser atmosphere, the RBCU's must run in low speed to prevent damage to the fan motor. [+1.5]

REFERENCE

1. Oconee: OP-OC-SPS-SY-RBC, p. 17 of 30.

ANSWER 4.03 (2.00)

1. Fuel in the core with RCS pressure >= 350 psig. [+1.0]
2. Fuel in the core with RCS temp >= 250 degrees. [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-BS, p. 14 of 18.

2. Oconee: Technical Specifications, 3.3.5.

ANSWER 4.04 (1.00)

(b.) [+1.0]

REFERENCE

1. Oconee: OP-OC-SPS-SY-LPI, p. 14 of 26.

ANSWER 4.05 (2.00)

Shutdown margin is the amount by which the reactor is shutdown OR, if critical or at power, the amount by which it would be shutdown upon reactor trip. The worst case stuck rod is assumed to be out. [+2.0]

REFERENCE

1. Oconee: PT/1/A/1103/15, p. 2.

2. Oconee: Technical Specifications, 3.1.11.

ANSWER 4.06 (1.50)

All control rods are withdrawn to or beyond the insertion limits of the rod position limits curves. [+1.5]

REFERENCE

1. Oconee: OP-OC-SPS-APC-T47.

ANSWER 4.07 (1.00)

(d.) [+1.0]

REFERENCE

1. Oconee: IC-RPS-RO-1k, QB.

ANSWER 4.08 (2.00)

1. Control Rod Groups 1-7 drop into core.
2. Turbine - generator trips.
3. Unit auxiliaries transfer to CT1.
4. Turbine bypass valves open at approximately 1010 psig.
5. Feedwater runback to control S/G level.

[+0.4] each.

REFERENCE

1. Oconee: EP/1A/1800/01, p. 2.

ANSWER 4.09 (1.50)

1. Trip all Reactor Coolant Pumps. [+0.5]
2. Manually initiate HPI. [+0.5]
3. Raise OTSG level to 95% on the Operate Range. [+0.5]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 13 of 142.

ANSWER 4.10 (1.50)

There is a figure in the Emergency Procedure that correlates XSUR level with operating range level of 85%, 95%, and 50% for varying steam generator pressures. [+1.5]

REFERENCE

1. Oconee: EP/1/A/1800/01, Enclosure 7.3A, p. 1 of 2.

ANSWER 4.11 (1.00)

Start the standby HPI pump and open the normal makeup injection nozzle, 1 HP-26. [+1.0]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 8 of 142.

ANSWERS -- OCONEE 1, 2&3 -86/07/15-HUENEFELD, J.

ANSWER 4.12 (1.00)

1. RCS temperatures increasing.
2. RCS pressure increasing.
3. PZR level increasing.
4. SG level low.

[+0.25] each.

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 9 of 142.

ANSWER 4.13 (2.00)

a. The ability to feed a SG is lost and RCS pressure >= 2300 psig. [+1.0]

b. 1. Manually initiate HPI. [+0.5]
   2. Open the PORV and PORV block valve. [+0.5]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 16 and 22 of 142.

ANSWER 4.14 (.50)

FALSE. [+0.5]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 24 of 142.

ANSWER 4.15 (1.00)

Start the RCP, let it run for 10 seconds, then manually trip it. [+1.0]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 27 of 142.

ANSWERS -- OCONEE 1, 2&3 -86/07/15-HUENEFELD, J.

ANSWER 4.16 (1.00)

Because BWST inventory is being lost out of the SG tube leak, and is therefore not recoverable for LPI recirc to the sump for long-term cooling. [+1.0]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 47 of 142.

ANSWER 4.17 (1.00)

3000 gpm (in each header). [+1.0]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 80 of 142.

ANSWER 4.18 (1.00)

500 gpm. [+1.0]

REFERENCE

1. Oconee: EP/1/A/1800/01, p. 90 of 142.

ANSWER 4.19 (1.50)

To maintain <500 gpm. [+0.5] (0.75)

With core subcooling >50 deg F (HPI may be throttled to maintain RCS P/T). [+0.5] (0.75)

~~LPI flow >1000 gpm in each injection line for at least 20 minutes and stable. [+0.5]~~

REFERENCE

1. Oconee: EP/1/A/1800/01.

EQUATION SHEET

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

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

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

---

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

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

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

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

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

<u>Water Parameters</u>

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

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

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

<u>Miscellaneous Conversions</u>

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

1 hp = 2.54×10^3 Btu/hr

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

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

ENCLOSURE 3

DUKE POWER COMPANY

OCONEE NUCLEAR STATION

SENECA, S. C. 29679

P. O. BOX 1439

TELEPHONE: AREA 803
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July 17, 1986

Mr. John Munro
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ATTENTION: Mr. Lawerence Lawyer
Chief Examiner

SUBJECT: LPRO Exam Review

Please find attached the comments concerning the LPRO exam given at the Oconee Nuclear Station on July 14, 1986. These comments are divided into two sections; Section I is a technical review by Training Center instructors. Section II is a review by Training Center Educational Specialists.

The exam review by Training Center instructors produced few valid comments concerning Technical materials in light of the existing regulatory environment. Most comments deal with additional information usable as correct answer material.

The exam review by the Educational Specialists dealt with test question construction and exam composition. Comments are meant to be constructive to improve the NRC's exam bank as it is developed. These same standards are endorsed by INPO and will be used to develop and revise the exam bank at the Oconee Training Center.

If there are any questions concerning these comments, please contact Paul Stovall at the Oconee Training Center, (803) 882-6150 ext. 2252.

Sincerely,

M.S. Tuckman/RLS

Mike S. Tuckman
Station Manager
Oconee Nuclear Station

Attachment

MST/PMS/jg

SECTION I

SPECIFIC COMMENTS

1.0 Principles of Nuclear Power

1.01 b This question indicates that a negative reactivity was made which made the core subcritical. If the core is made subcritical and remains subcritical as is indicated by a stable negative startup rate in the expected answer the resultant stable negative start up rate will be a - 1/3 dpm (-80 sec period).

The correct answer to part b of question 1.01 should therefore be a prompt drop of a lesser magnitude than part a, as is indicated on the answer key, but the resultant negative startup rate would be the same.

References: (Oconee references previously provided)

Oconee: Fundamentals of Nuclear Reactor Engineering
pg. 105-106

Oconee: OP-OC-SPS-RT-FP
pg. 19 of 25

Generic: Nuclear Reactor Engineering, Glasstone & Sesonshe 1967, pg. 247 para. 5.39; 5.47

1.02 a The answer to this question could also be a "just critical" reactor since no scale is provided on either axis. A core made "just critical" by the last rod pull will behave as a subcritical reactor in regards to startup rate. In order to achieve a stable steady startup rate the reactor must actually be made supercritical.

References: (previously provided)

Oconee: Fundamentals of Nuclear Reactor Engineering
pg. 118-120

Oconee: OP-OC-SPS-RT-SM
pg. 21 of 22

1.04 In addition to the two answers given on the Answer Key a third acceptable answer would be the decrease in competition for the available thermal neutrons caused by the removal of boron over core life.

Reference: (previously provided)

Oconee: OP-OC-SPS-RT-FPP
pg. 18 of 33

1.06 b Another possible answer to this question would be "more overmoderated". While the core is undermoderated by design, it is possible to appear overmoderated with very high boron concentrations, such as following a refueling outage. If the boron is subsequently increased further the core would appear to become "more overmoderated."

References: (previously provided)

Oconee: Fundamentals of Nuclear Reactor Engineering
pg. 153-154

Oconee: OP-OC-SPS-RT-RC
pg. 18 and 19 of 26

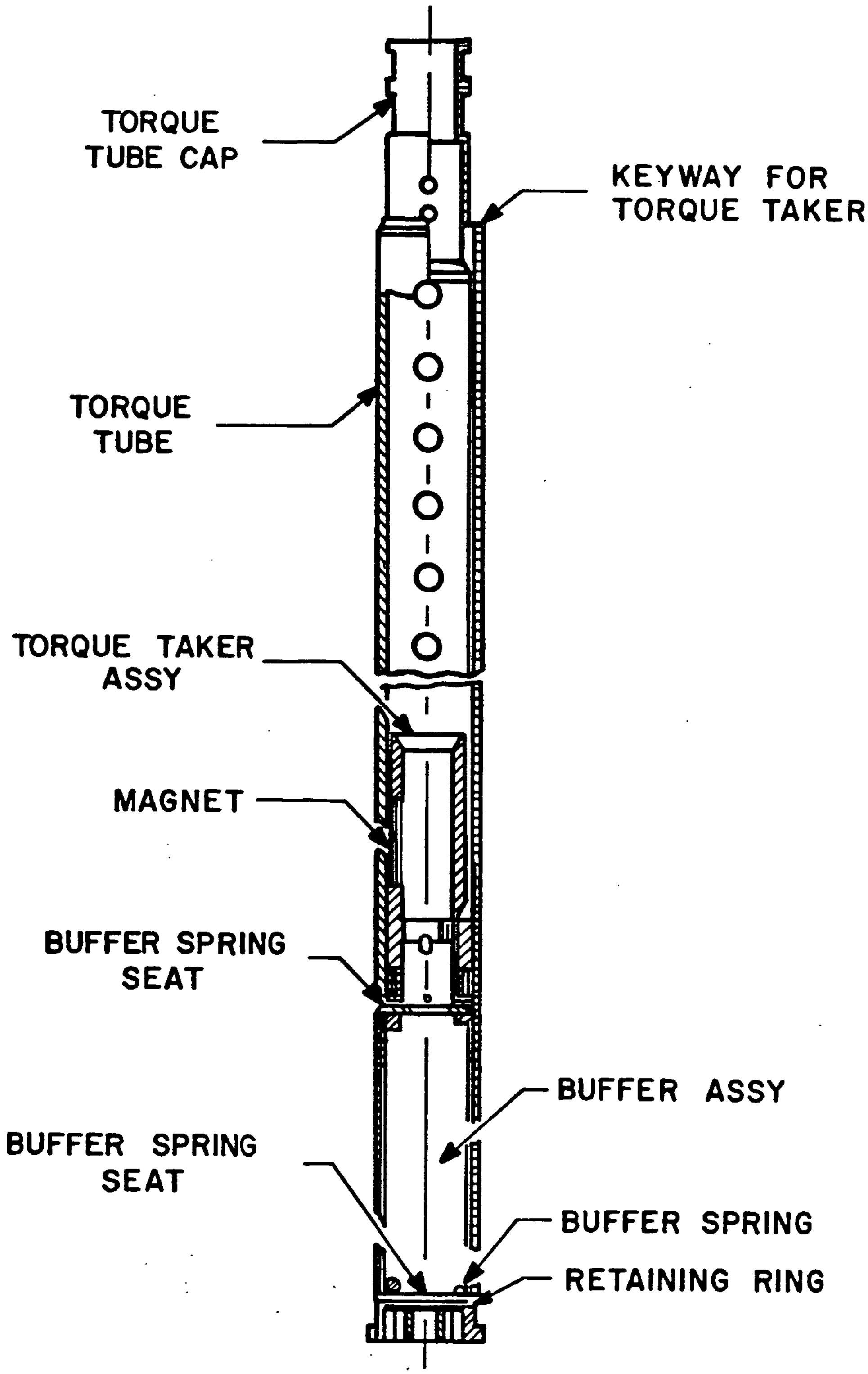
1.09 In addition to the answers given on the Answer Key using the emergency feedwater nozzles also:

1. Results in a larger ΔT between the RCS and feedwater since feedwater is sprayed directly on the SG tubes without being preheated by aspirating steam in the preheat region or if emergency feedwater is being used it will be at a lower temperature than main feedwater feedwater.

2. Raises the heat sink thermal center without necessarily increasing steam generator level (area) - this increase in thermal center is beneficial in achieving and maintaining natural circulation if RCPs are secured.

Reference:

Generic: B&W ATOG Reference Document Volume I, Part II
pg. 20 and pages 46 and 47



TORQUE TUBE ASSEMBLY

Control Rod Drive Mechanism	
Torque Tube Assembly	
OC-CM-CRD-6	3-84
Ref: Tech. Manual	
Drawn: RLB	App: RAB
Training Use Only	

2.0 Plant Design Including Safety and Emergency Systems

2.09 The makeup line in the reference refers to the loop injection lines for makeup to the RCS not the makeup line to the LDST. The makeup path to the LDST is heat traced up to the letdown filters and the piping between the letdown filters and LDST is minimized.

Limits and Precautions of the Soluble Poison Concentration Control Procedure, OP/1(2)(3)/A/1103/04 states that the limit of 8750 ppm boron concentration applies at the LDST. This is because the primary concern with extremely high boron concentrations is the possibility of crystallization occurring in areas of close tolerances such as the RCP seals.

References: (previously provided)

Oconee: OP-OC-SPS-SY-RCS
pg. 20 of 24

Oconee: OP/1(2)(3)/A/1103/04 Limits and
Precautions 2.5

2.11 The answer given on the Answer Key for the RCPs addresses the cooling jackets and seal coolers which is accurate for the Bingham RCPs on Units 2 and 3. The Westinghouse RCPs on Unit 1 are different. On the Westinghouse RCPs the labyrinth seal and thermal barrier is cooled by Component Cooling.

Reference: (previously provided)

Oconee: OP-OC-SPS-CM-CPS
Drwg: OC-CM-CPS-2 and 4

2.20 The mechanical buffer is the buffer spring which accepts the final kinetic energy of the rod. This buffer action is not lost due to improper venting. Improper venting will result in loss of the hydraulic buffer that would have been provided by coolant passage through the holes in the torque tube.

Reference: (previously provided)

Oconee: OP-OC-SPS-CM-CRD
pg,. 12 of 14 and
Drwg: OC-CM-CRD-6

2.23 To know the failure mode of these valves should be expected of the operator. The pressure at which they fail is beyond that expectation. Information contained in Enclosure 6.1 is for reference by the operator should he have a failure of the Instrument Air System. Enclosure 6.1 provides the operator with expected responses of various systems so that the operator does not need to memorize the specific pressures that these responses occur.

Also the turbine bypass valves are not addressed in the current AP/1/A/1700/22 (dated 2/7/86)

Reference: (previously provided)

Oconee: AP/1/A/1700/22, Enclosure 6.1

3.0 Instruments and Controls

3.04 Another possible answer to this question is that if CC7 or CC8 is closed the CC pumps may not be started or if a CC pump(s) is running it will trip.

This information was added to Oconee: OP-SPS-SYCC after the information was transmitted. The change is supported by OEE-142-06 attached.

3.07 The minimum temperature for starting the fourth pump on the Answer Key is incorrect. The current setpoint is Tc > 325°F. The setpoint for this interlock changes frequently and varies between the units and therefore the operator will reference the procedure when starting the fourth RCP. It is understood that setpoints were not required in the answer from the candidates.

Reference: (previously provided)

Oconee: OP/1/A/1103/06 Limit and Precaution 2.14

3.08 The question did not limit the expected answer to only the response of the RB Cooling System's response to ES 5 and 6. In addition to the answer given on the Answer Key the Penetration Room Ventilation fans will start and Essential Reactor Building Isolation will occur.

Reference: (previously provided)

Oconee: OP-OC-SPS-IC-ES
pg. 7 and 26 of 26

3.12 In addition to the answers given on the Answer Key another possible answer would be the ICS Tave circuit which receives input for T_h.

Reference: (previously provided)

Oconee: OP-OC-SPS-IC-RCI
pg. 11 of 41

3.16 a Wording on this question was misleading. The question did not specify to list those parameters that trip RPS or activate the Emergency Feedwater System.

As the question is presently worded other acceptable answers would be:

- Feedwater Pump Turbine RPMs
- Feedwater Pump Turbine Stop Valve Indication
- Both FDW pumps tripped stat-alarm
- FWP flow minimum stat-alarm
- FWP flow below minimum stat-alarm

Reference: (previously provided)

Oconee: OP-OC-SPS-SY-FDW
pg. 10 of 27

3.17 The correct answer to this question depends on where the interruption occurs. If the source of interruption occurs at KVIA then the correct answer is TRUE as is indicated on the Answer Key.

If the source of interuption occurs at the RPS cabinet (such as opening the breaker located in the top of RPS Channel A) the correct answer would be False.

Reference: (previously provided)

Oconee: OP-OC-SPS-IC-RPS
Drwg: IC-RPS-24A

3.18 b The administrative limit on the nuclear over power trip setpoint when in shutdown bypass is ≦ 5.0% of rated power per Technical Specifications. The Controlling Procedure for Unit Shutdown, OP/1(2)(3)/A/1102/10 further reduces the setpoint to 4.0% of rated power.

Reference: (previously provided)

Oconee Technical Specification 2.3

Oconee: OP/1(2)(3)/A/1102/10

3.20 The Sync Verification Indicator lamp operation is based on a voltage differential generated when the AC line and Inverter output are out of phase. A voltage mismatch between these two sources will cause the lamp to burn continuously at half brightness.

The OP-OC-SPS-EL-VPS lesson plan reference in the Answer Key addresses the condition where the inverter voltage is normal and the AC line voltage is low. Although not addressed there are other conditions which would generate a voltage mismatch.

Reference: (previously provided)

Oconee: OP-OC-SPS-EL-VPS
pg. 13 of 26

4.0 <u>Procedures - Normal, Abnormal, Emergency and Radiological Control</u>

4.02 The answer in the Answer Key gives the reason for not having the switch in the "Auto" position. The wording of the question may also be interpreted to be asking why the third RBCU can not be running with two units in High.

In this case a possible answer would be that operation of three RBCUs in high speed is not permitted because the idle fan would be rotating in reverse when it was started and would have excessive starting torque causing it to trip off on over current.

Also, mixed speed combinations of RBCUs can not be used because the RBCU(s) running in High will cause excessive back pressure against a RBCU running in Low speed and could cause fan or motor failure.

Reference: (previously provided)

Oconee: OP-OC-SPS-SY-RBC
pg. 17 of 30

4.03 Other possible answers to this question involves the removal of a RBS train from service.

When critical, operation with one of the RBS trains inoperable is limited to 24 hours.

When critical, with all three of the RBC trains operable, one of the RBS trains may be removed from service for seven days.

Reference: (previously provided)

Oconee: Technical Specification 3.3.6

4.19 Another possible answer involves throttling HPI during SG tube leak. In Section 504 of the EOP the operator is told to monitor tube-to-shell ΔT while maintain a subcooled margin of 1 - 10°F. This may require throttling HPI after it has initiated

The criteria of LPI flow greater than 1000 gpm in each injection line for at least 20 minutes and stable is criteria used to <u>secure</u> the HPI system rather than throttling HPI flow. The interpretation of this question may cause some candidates to omit this answer. One candidate (Mike Austin) asked for clarification on this question and based on the guidance given omitted this part of the answer:

References: (previously provided)

Oconee: EP/1/A/1800/01 Section 504
pg. 60 of 142

and CP 601
pg. 84 of 142

SECTION II

<u>General Comments</u>:

1. Clear directions at beginning of test with cues given within test i.e., SELECT ONE, ANSWER TRUE or FALSE, etc., which help students respond correctly.

2. Test format was good and author had edited. (No typing errors.)

3. For the most part the intent of the questions were clear.

<u>Recommendations</u>:

1. State the question first followed by supporting information. This eliminates the need to read the questions a second time.

   Reference: <u>Test</u> <u>Construction</u> by Norman Grontund.

   NOTE: Attached sheets identify specific questions where this problem occurs.

SPECIFIC COMMENTS

1.0 Principles of Nuclear Power

1.01 b. Awkward wording

1.02 a. "Explain" tends to indicate a lengthy answer is needed, but response is very short.

1.05 a. Need to identify what must be done at the beginning of the question e.g.,

On your answer sheet sketch the resultant effect of a fully inserted rod, corresponding to the centerline of of the reactor, has on the flux shape.

1.07 Are trainees expected to know the levels of all tanks in the plant? Seems like that information should have been included in the question.

1.08 Awkwardly Stated.

1.12 Awkward?

What percent of the NEGATIVE reactivity is available for a control rod stuck in the core at the 25% rod index position (3/4.......core)?

2.0 Plant Design Including Safety and Emergency Systems

2.04 State question first.

2.07 Questions should have only one correct response.

2.09 Reword - What problem is associated with... established?

2.14 Reword: Give two reasons why the RCPs do not rotate in the reverse direction.

2.15
2.17
2.19 State the question first.

2.23 Awkwardly stated.

What is the air pressure and position of the values listed below when they fail during a loss of instrument air?

3.0 Instruments and Controls

3.01
3.02 State the question first.

3.08 Word to reflect response expected.

3.09 State the question first.

3.10 Expectations would be clearer if question said, "List the 6 controls."

3.12 State question first.

3.14 Use of the word "characteristics" implies more than one response.

3.16 a. Not specific enough.

3.19 Delete "fast acting make before-break".

Statement is not needed and tends to confuse.

4.0 Procedures - Normal, Abnormal, Emergency and Radiological Control

4.02 State question first. Intent of question unclear.

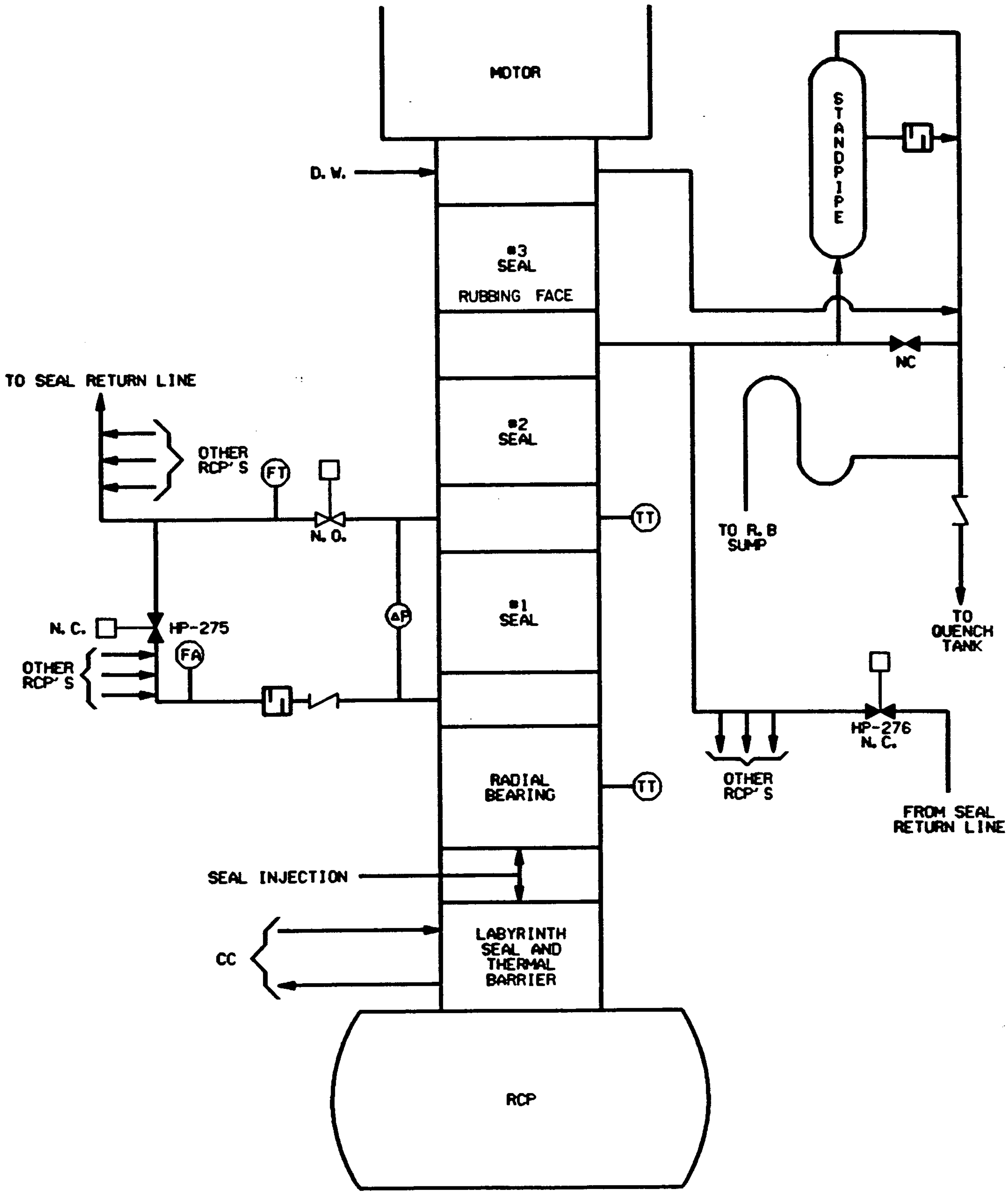
4.04 Convert all responses to minutes.

4.06
4.07
4.09 State question first.

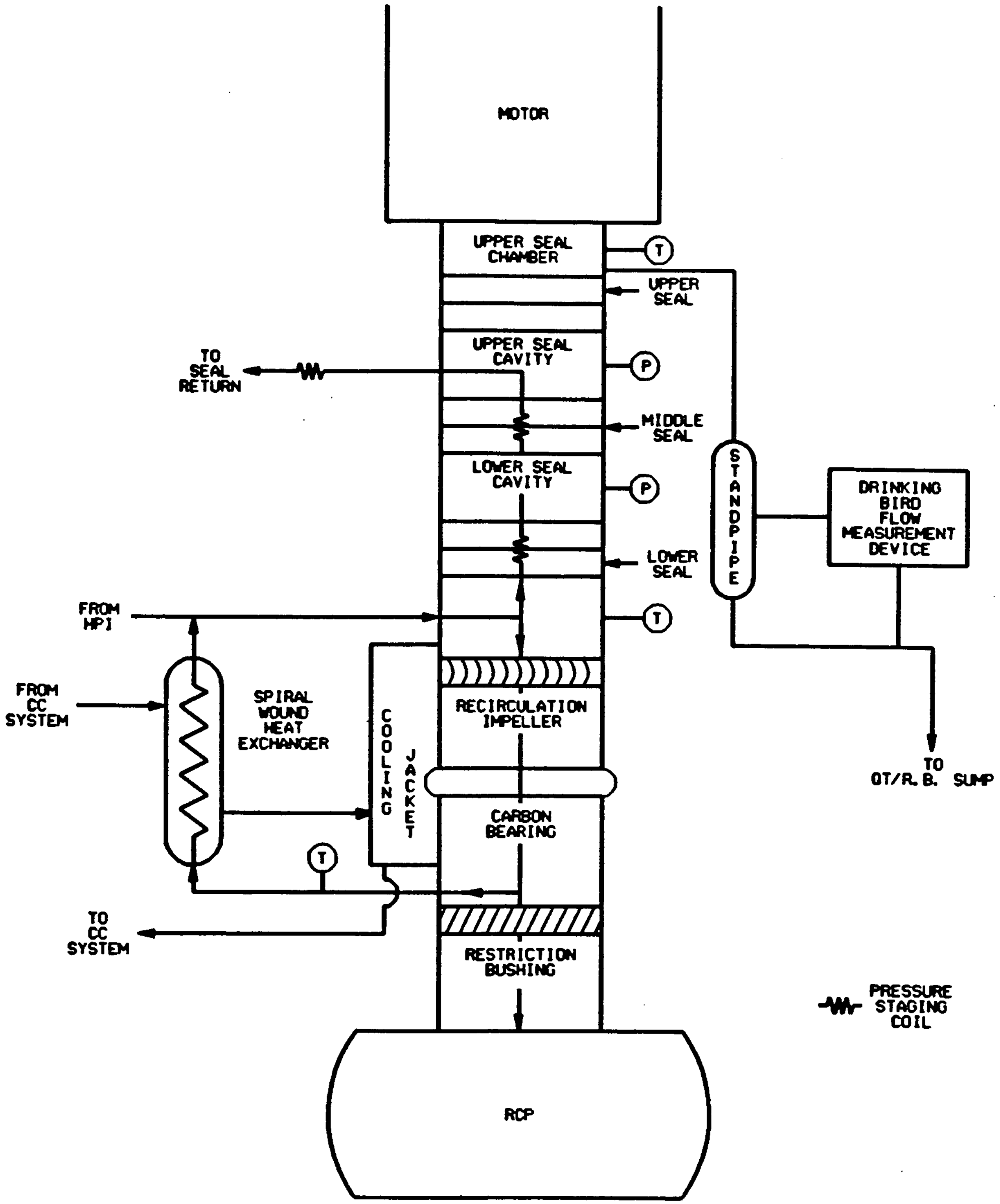
4.13 a. Awkward

4.19 Awkward

If HPI has been automatically initiated, what circumstances permit it to be throttled?



TITLE: COOLANT PUMP SEALS	NOTES: WESTINGHOUSE COOLANT PUMPS 1) UNIT ONE ONLY	ID NO: OC-CM-CPS-2	DATE: 12-31-85
		REF. WESTINGHOUSE INST BOOK REV. Ø	
		DRN BY: GDF/RWP	APR BY: RPB
		TRAINING USE ONLY	



TITLE: COOLANT PUMP SEALS	NOTES: BINGHAM COOLANT PUMPS 1) UNITS TWO AND THREE ONLY 2) STAGING COILS ARE INTERNAL TO SEAL #1 AND 2	ID NO: OC-CM-CPS-4	DATE: 12-12-85
		REF. OFD-100A-2.3 & 3.3, REV.0	
		DRN BY: GDF/RWP	APR BY: RPB
		TRAINING USE ONLY	