U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-315/OL-85-01

Docket No. 50-315/316 License No. DPR-58/74

Licensee: American Electric Power Service Company
1 Riverside Plaza
Columbus, Ohio 43216

Facility Name: D. C. Cook 1 and 2

Examination Administered At: Bridgman, Michigan

Examination Conducted: RO and SRO Writtens and Orals

Examiners: T. Burdick — 4-4-85 Date

R. Higgins — 4/8/85 Date

T. Reidinger — 4/8/85 Date

R. Ferrell — 4/4/85 Date

A. Vinnola for — 4/7/85 Date

R. Sailor — 4/9/85 Date

P. Isaksen — 4/9/85 Date

Approved By: J. I. McMillen, Chief
Operator Licensing Section — 4/9/85 Date

Examination Summary

Examination Administered on February 26-28, 1985 (Report No. 50-315/OL-85-01

Results: 10 RO and 9 SRO candidates took the written and oral examinations. All candidates passed the oral examinations. One SRO and one RO failed the written examination.

REPORT DETAILS

1. Examiners

*T. Burdick
R. Higgins
T. Reidinger
R. Ferrell
A. Vinnola
R. Sailor
P. Isaksen

*Chief Examiner

2. Examination Review Meeting

T. Burdick, R. Higgins and R. Ferrell met with members of the plant staff to allow the licensee an opportunity to review and comment on the examinations after the written examinations were completed. Those comments and their resolution are as follows:

QUESTION 1.12: The question asked the student to select from four (4) possible choices the cause of the actual critical rod position being lower than the ECP. Two possible choices were:

a. Overfeeding the steam generators
b. Underestimating the boron concentration by 5 ppm

COMMENT: a. This choice does not reflect the possibility of a positive moderator temperature coefficient. This choice was reflected on the key as the correct answer.

b. This choice could be considered correct if modified to be the "critical boron concentration."

Since neither choice is 100% correct without qualification/ modification we request both/either answer(s) be accepted as correct.

EXAMINER RESPONSE 1.12: We agree with the facility and will award full credit for either response.

QUESTION 1.15: The question asked the student to select from four (4) possible choices the proper action assuming the axial flux difference was outside the target band. The selection of the correct choice required VERBATIM knowledge of the action statement of TECH SPEC. 3.2.1, AMENDMENT 61.

COMMENT: Section E of Examiner Standard ES-202 of NUREG 1021, OPERATOR LICENSING EXAMINER STANDARD OF OCTOBER 1983. Point 1 states: "Technical Specification questions for reactor operator should be conceptual in nature." This question requires a level of detail far, far in excess of the standard and should be deleted from the exam.

EXAMINER RESPONSE 1.15: We disagree with the reviewer. The RO should know when the AFD band is in effect and the consequences of its violation.

QUESTION 1.24/1.25: EXAMINER STANDARD ES-107 of NUREG 1021 point 12 requires that "lone questions" be flagged on the previous page by a "continued on next page" statement.

COMMENT: Contrary to the above no such statement appeared on the exam following Question 1.24 and Question 1.25 was a "lone question".

We request that continuation statements be used as required by the standard.

EXAMINER RESPONSE 1.24/1.25: This comment is irrelevant since the examination was already completed at the time of the review. No examinees overlooked question 1.25.

QUESTION 2.02: The question asked the student to describe the method (flow path control) by which the RCS cooldown rate is controlled by the RHR system.

COMMENT: Some portions of the Answer Key were not elicited by the question and we request that they not be required to receive full credit. This included the information contained within the parentheses, as well as information concerning heat transfer from the RCS to CCW and the fact that reactor coolant flows through the tube side of the heat exchanger. Specifically stated, the method of controlling cooldown is to vary the amount of flow bypassing the heat exchanger.

EXAMINER RESPONSE 2.02: Disagree - Candidates should realize heat is being transferred from RCS to CCW via the HX to perform cooldown of RCS. Comment in Section 3 is in the answer.

QUESTION 2.06: The question asked the student to provide information concerning the operation of the ECCS equipment during a LOCA.

COMMENT: Based on the initial pressure of 2235 psig the charging pump would already be injecting into the RCS. We request listing the charging pump not be required for full credit and that 2235 psig be accepted as correct if given.

The question does not state the number of responses required which is in violation of NUREG-1021, ES-202, Point 18 concerning Open-ended questions.

EXAMINER RESPONSE 2.06: Agree - Training material provided is inconsistent. The referenced answer is correct but changed answer key to accept the different pressures.

Do not agree that the question is open-ended as it was specific in asking for all ECCS components of which the candidates should have adequate knowledge.

QUESTION 2.07: The question asked the student to describe how leakage is detected from the Spent Fuel Pit.

COMMENT: The last sentence of the Answer Key concerning the routing of the liquid from the leak detection system for reprocessing was not elicited by the question.

We request that this information not be required for full credit.

EXAMINER RESPONSE 2.07: Agree - Answer key changed.

QUESTION 2.09: This question required the student to explain the function of Interlock bypass switches on the manipulator crane.

COMMENT: 10 CFR 55.22 specifies that items concerning "Procedures and limitations involved in initial core loading alterations in core configuration..." and "Fuel handling facilities and procedures" are applicable to Senior Operator exams as well as the items listed in 10 CFR 55.21 which specifies the exam content for Reactor Operators. This implies that fuel handling questions are beyond the scope of a Reactor Operator exam.

Reactor Operators do not perform any jobs associated with refueling cranes. PMI-4050 states that:

"The maintenance Superintendent is responsible for preparing fuel handling procedures, as required, to accomplish fuel handling in a safe and efficient manner and to provide trained personnel to operate and maintain the tools and cranes used in fuel handling activities.

The Maintenance Supervisor assigned by the Maintenance Superintendent shall be responsible for any fuel movement, except as otherwise specified by this PMI or by approved written procedures and instructions which may be developed for specific jobs.

The Operations Superintendent is responsible for providing Senior Reactor Operators for fuel handling as directed by the Technical Specifications."

We request this question be deleted from the exam.

EXAMINER RESPONSE 2.09: Although the licensee states that he does not use the reactor operators in this function, it is knowledge not specifically excluded by NUREG-1122. Deletion of this question would have no impact on the outcome of pass or fail status.

QUESTION 2.12: This question asked the student to state the purpose of the pressurizer safety line loop seals and describe how they are formed.

COMMENT: The loop seal lines on the pressurized safeties are currently being drained back to the pressurizer. (See attached RFC Final Summary Report RFC-DC-12-2662). We request that you recognize that this is a dynamic situation and accept either the Keyed answer or a discussion of the current configuration for full credit.

EXAMINER RESPONSE 2.12: Agree - Training Material provided does not indicate this new design. Master answer key changed and half credit taken off if candidate did not discuss new design.

QUESTION 2.14: This question asked the student to state the purpose of the Containment Spray Eductors and how they operate.

COMMENT: The following points were stated in the answer key and were not elicited by the question. We request that they not be required for full credit.

The design of the eductors is to meter the proper amount of NaOH.

The eductors are self priming and require no operator action.

EXAMINER RESPONSE 2.14: Disagree - Explaining operation of eductors will require knowledge of design or at least a discussion of eductor flow rates which would be acceptable. Comment on specific number of responses not asked for is not applicable to this question.

QUESTION 2.15: This question asked the student to respond TRUE or FALSE to five statements concerning the main generator and auxiliary systems.

COMMENT: Part 2.15.e is true for Unit 1 and false for Unit 2. Since no Unit was specified we request that either true or false be accepted as correct. Reference: PGS-13A-59 and PGS-13B-59.

EXAMINER RESPONSE 2.15: Agree - System Description not specific in this area. Answer key corrected.

QUESTION 2.17: This question asked the student to "Briefly describe the operation of the electric hydrogen recombiners located in Containment during a LOCA."

COMMENT: This question is insufficiently clear as to whether a description of the principle of how the recombiners work or how they are operated is required. We request that the following be accepted for full credit as well as the keyed answer.

A recombiner is started by placing its control switch in RUN, adjusting the power supplied to the electric heaters, and monitoring the recombiner temperatures. Reference: NS-15-39.

EXAMINER RESPONSE 2.17: Disagree - Question asked "Describe the Operation."

QUESTION 2.18: This question asked the student to describe the operation of the Main Turbine Turning Gear and how the turbine is placed on the gear.

COMMENT: The question does not elicit the detail given in the Answer Key. The question does not specify the Unit for which the response is required. We request that either answers given below be accepted for full credit.

Unit 1 - The pre-engagement motor is used to provide engaging torque then the shaft is stopped. The turning gear motor and continues turning the main turbine shafter after the turning gear is engaged. The motors must be running to engage the turning gear which is then manually or remotely engaged. Reference: PGS-4A-25

Unit 2 - The turning gear motor turns the shaft through a hydraulic coupling and reduction gear drive. To place the main turbine on the turning gear, the control switch is placed ON. There is no manual method of engaging. Reference: PGS-4B-23,24.

EXAMINER RESPONSE 2.18: Disagree - Answer will not require exact information for full credit. Full credit will require both answers provided above in comments since question was not specific.

QUESTION 3.01: The question asks for the purpose of the D/G HEA Lockout Relay switch.

COMMENT: We feel that a sufficient answer for "purpose" could be "The operation of this relay and its associated contacts determines operational status of the D/G start/Run electrical circuitry and allows all necessary auxiliaries to operate as necessary. After a trip signal has been received, the HEA relay is energized and is released from the "RESET position" and is "locked out" until manually reset.

We request that the answer to this question reflect only the purpose for the HEA Lockout relay switch. Reference: AS-10-59.

EXAMINER RESPONSE 3.01: Disagree - Purpose of switch could not be explained unless positions of switch are discussed.

QUESTION 3.02: Examiner chose to add another acceptable answer to the key.

QUESTION 3.03: The question asked for conditions giving the "Ice Condenser Refrigeration System Abnormal" annunciator.

COMMENT: The alarm "ICE COND. REFRIG. SYSTEM ABNORMAL" (Ann. 22 Drop 88 - 1-OHP 4024.122.088) does not list alarm conditions. In order to find conditions to the alarm, one of two courses must be consulted. The first is the ICE COND. REFRIG. SYSTEM ABNORMAL;" only four conditions are stated in the Answer Key. The Answer Key should reflect the fact that all alarms on Ann. 35 cause the plant service alarm or a list of all possible should be included in the Key.

We request that the Answer Key reflect all possible answers.

EXAMINER RESPONSE 3.03: Agree. Answer key corrected even though question was taken directly from system description provided by facility.

QUESTION 3.04: The question is in reference to a pressurizer level channel failing low.

COMMENT (A): The question, which was what happens to charging flow, does not ask for the status of backup heater and letdown isolation.

We request that the acceptable answer reflect magnitude (increase, decrease) of change in charging flow.

COMMENT (C): Part (C) may have an additional correct answer. Simulator experience shows that for all controls in automatic, a refueling water sequence on LO-LO VCT level may occur prior to High Level Reactor Trip and resulting in possible OTΔT trip.

We request that full credit be given either for this alternative answer or for the answer in the Key.

COMMENT (D): VCT automatic blend set point for ending the blend (and makeup) occurs at 24% vice 44% per Table NS-6-II.

The point values assigned for the entire question do not correspond to the number of answers required.

We request that 24% set point be reflected in Answer Key.

We request that point values for all portions of this question correspond to the number of answers required.

EXAMINER RESPONSE 3.04

(A): Disagree. Information in brackets not required for full credit. Number of items required is not applicable.

(C): Agree. Answer key Corrected.

(D): Disagree. Point values assigned are adequate; makeup setpoint corrected in answer key.

QUESTION 3.05: The question was what could cause the "Regen Ht. Ex. Ltdn Temp High" annunciator and what action can the operator take.

COMMENT: This question is open-ended; no specific number of responses are requested in the question. It is open to the Operator to supply an undefined amount of answers, but be held responsible for those of the annunciator response.

We request that specific annunciators be allowed as acceptable answers and that above comments be reflected in the grading.

EXAMINER RESPONSE 3.05: Disagree. Question is based on recall of systems drawing only, not total recall of annunciator response procedures. Candidates should be able to recognize what would actuate the temperature alarm in the pipe.

QUESTION 3.08: This question is related to inputs to the variable gain unit for rod control.

COMMENT (A2): The inputs to the variable gain unit are from the non-linear gain unit and turbine impulse pressure. The Answer Key reflects that the inputs are NI's and turbine impulse pressure. The answers from the Operators can be quite varied since the inputs to the rod control circuit as a whole are AUCTIONEERED HIGH NUCLEAR POWER, TURBINE IMPULSE, and AUCTIONEERED HIGH TAVG. The signal supplied to the variable gain unit is a compared signal (POWER MISMATCH RATE COMPARATOR) based on auct. high nuclear power and turbine impulse. The signal is then massaged to convert and amplify the signal (NON-LINEAR GAIN UNIT) for supply to the variable gain unit.

We request that the non-linear gain unit be allowed as a correct answer in addition to nuclear power, T_{avg} and turbine impulse.

EXAMINER RESPONSE 3.08: Agree. Answer key corrected to reflect alternate answer.

QUESTION 3.09.b: The question refers to a pressurizer pressure channel failing.

COMMENT: The Answer Key does not reflect the fact that the possibility exists that the failed channel could be either a control or a bistable channel. Taking this into account, we feel that the weighting of the answer could be shifted.

We request that the failure of either type of channel be accepted for full credit.

EXAMINER RESPONSE 3.09b: Disagree. This was clarified to candidates during the exam and incorporated into master key.

QUESTION 3.10: The examiner reduced the required answer for full credit.

QUESTION 3.12:

COMMENT: We request that full credit be given for reasonable answers to this question since the question does not state a specific requirement for responses.

EXAMINER RESPONSE 3.12: Disagree. Not applicable to question.

QUESTION 3.13:

COMMENT: This question does not include the requirement of listing set points.

Request that the set points be eliminated from the answer.

EXAMINER RESPONSE 3.13: Disagree. Answer requires setpoints as question asks for interlocks.

QUESTION 3.14: The question asked for interlocks for the steam dump system.

COMMENT: The training article identifies only two interlocks in the steam dump system (PGS-12-31):

(1) C-9 Cond. vacuum/circ pump breaker position
(2) P-12 low-low tavg

The choice of the word "interlock" is misleading in relation to the methods in which the system is now taught. With the wide disparity in the uses of the words, "interlock", "permissive," and "conditional," the system is taught as to what inhibits steam dump operation. The items taught as inhibiting operations are:

(1) Steam dump control selector switch.
(2) Condenser pressure 3/3 10.6 inches (Hg)
(3) Circulating water pump breaker position
- at least one breaker closed.
(4) Steam dump mode selector switch.
(5) P-12 Low-Low T_{avg}.

If the answer you desire is to reflect material in the training article, we feel point credit should reflect half credit for each interlock vice point values for individual inputs. If the answer desired is for items inhibiting dump operation the above 5 items should be considered.

We request that credit be given for the above additional answers and that C-9 be allowed to represent two (2) of the correct responses.

EXAMINER RESPONSE 3.14: Disagree. Question per system description. Number of responses requested is not applicable as candidate should know all steam dump interlocks.

QUESTION 3.17: This question refers to the block/unblock switches for the pressurizer PORV's.

COMMENT: The pzr porv lift set is 2335 psig at its high pressure set point. The question does not elicit a response requiring a set point in the answer.

We request that the set point be eliminated from the answer. Reference: 1-OHP 4024.108 (Ann. 8 Drop 16, det.)

EXAMINER RESPONSE 3.17: Disagree. Operation of system is based on two setpoints in answer. Answer key corrected to reflect new setpoint versus one found in system description.

QUESTION 3.18: The question asked how the PORV's are prevented from depressurizing the RCS on a single channel failure.

COMMENT: The answer reflected in key is incorrect based on out-dated information in the training article. The system no longer works the "old" way. The "new" system operation has a new set of 2335 psig.

We request that the Answer Key be modified to represent current system and that the set point be deleted since it was not requested.

EXAMINER RESPONSE 3.18: Agree. Answer key corrected to reflect new setpoint versus one found in system description.

QUESTION 4.01: The question asked for D. C. Cook Plant dosimetry requirements.

COMMENT: In addition to a monitor badge (TLD) and self-reading dosimeter candidates may also respond with "high range self reading dosimeter." These high range devices are standard issue to all Operations personnel, and are required on all "tour" extended MWP's.

We request that the above comments also be allowed as a correct answer.

EXAMINER RESPONSE 4.01: The examiner finds this redundant and unnecessary.

QUESTION 4.03:

COMMENT: Answer Key uses TRUE or FALSE for response; question states answer YES or NO.

We request that the Answer Key be changed to YES or NO responses.

EXAMINER RESPONSE 4.03: Agree. Answer key corrected.

QUESTION 4.07:

COMMENT: Part (b) of the question appears to be an "open ended" question. NUREG 1021, ES-202 page 5 item 18 cautions that open ended questions should be avoided. We request that all three manual actions stated in the Answer Key not be required for full credit.

Part (c) of the Answer Key is correct in that Operators should isolate steam supplies to the turbine driven aux feed pump if the affected SG has not been identified; however, this is one of the first procedural steps in the procedure and is done whether or not the affected SG has been identified. Candidates may approach the question as to identifying the affected S/G by isolating aux feed flow to two S/G's at a time and watch for level increases. These steps appear on page 7 of 11 in 1-OHP 4023.001.004 Steps 5.2.10 and 5.2.11.

We request that the answer key be adjusted to allow credit for the above comment.

EXAMINER RESPONSE 4.07: Disagree. Answer per referenced procedure and operator should know all immediate actions of this procedure. Question not open ended per NUREG 1021.

QUESTION 4.10: The question asks for specifics which are not immediate actions.

COMMENT: The question and Answer Key require the candidate to quote procedural steps other than immediate actions. This is contrary to NUREG 1021 ES-202 Section 4 pages 2 and 3. The question and Answer Key require the candidate to quote a number directly from Technical Specifications. This appears to be contrary to NUREG 1021 Section 4 Part E Number 1 on page 3.

We request that the Answer Key be amended to reflect that verbatim quote and exact valves are not required for full credit.

EXAMINER RESPONSE 4.10: Disagree. When SDM must be verified should be general operator knowledge for fundamental understanding of plant operations.

QUESTION 4.13:

COMMENT: The correct valve numbers for the pressurizer PORV isolations valves are: NMO-151, NMO-152, and NMO-153. A 1 or 2 preceding this designation will identify the item as Item 1 or Item 2.

We request the Answer Key be amended to reflect the above comments.

EXAMINER RESPONSE 4.13: Agree. Answer key corrected.

QUESTION 4.16: We request that for part (a) only the first sentence of the Answer Key be required for full credit. The additional information provided in the key is valid and correct; however, this information is not elicited by the question.

Part (b) of the answer uses NS-12 page 55 and 56 for references. Considering the section of the exam, procedure OHP-4022.009.001 Step 2.1 would be a more valid reference. We request that answer key be amended to reflect that RHR spray is to be initiated if containment pressure rises above 8 psig following initial blowdown and full credit be allowed for this response.

EXAMINER RESPONSE 4.16: Disagree. Information in brackets not required for full credit. The answer key for part B already reflects the facility comments.

QUESTION 5.01: The question asked the student to state for five possible situations if the actual critical rod position would be higher, lower, or the same as the estimated critical position.

COMMENT: 1. Choice (b) stated a reactor coolant pump was turned off 1 minute before the reactor was critical and the answer given was "same." This answer ignores the reduction of heat input to the primary system by the RCP which would result in Tave decreasing, positive reactivity being added and a "lower" actual critical position, therefore, we request "lower" also be accepted as a correct answer for (b).

2. Choice (d) stated the startup was delayed by 2 hours and the key gave the correct answer as "lower." Since Xenon concentration and its reactivity effects vary dependent upon the time since shutdown and previous power history insufficient information was provided to elicit a specific response.

Therefore, we request this question be deleted.

EXAMINER RESPONSE 5.01: Removing one of four reactor coolant pumps will not result in a cooldown since the other three continue to heat up the system at a slightly lower rate. Also, the Xenon effect is obvious since the time after the reactor trip is given and the peak typically occurs less than ten hours following the trip regardless of the power history. This can be verified by referring to the licensee's technical Data Book, Tab 8. No changes were made to the exam in regard to this comment.

QUESTION 5.04: The question asked the student to identify one of four choices that was an indication of interruption of natural circulation. The answer key gave the choice of "steam generator pressure decreasing on loss of natural circulation."

COMMENT: Both answers (b) and (d) can be considered correct depending on the cause of natural circulation interruption. For example, if the loss of natural circulation is caused by a steam line isolation, steam generator level would decrease due to shrink and steam generator pressure would increase to PORV or safety setpoint. This condition makes (b) incorrect and (d) correct. This question should be deleted or both (b) and (d) should be accepted as correct responses.

EXAMINER RESPONSE 5.04: Answer (d) is not acceptable because steam generator level shrink is only associated with larger steam flow rate reductions and larger pressure increases. Under the conditions of natural circulation, the operator would not see any significant shrink as stated in the reviewer's comment. No changes were made to the exam.

QUESTION 5.05: This question concerned pressure control during natural circulation.

COMMENT: This question is "open-ended" in that the question was simply "why." This is in direct violation of point 18 of EXAMINER STANDARD ES 202. Also the answer given on the key is not contained in the stated reference.

We request that either answer be accepted for full credit or that this question be deleted from the exam.

EXAMINER RESPONSE 5.05: The examiner agrees and required only one answer for each part for full credit.

QUESTION 5.06: This question asked the operator to fill in the blanks with various times (ex., 0, 5, 10, 50, 80 hours) in regard to xenon.

COMMENT: 1. Response (a) asked for the number of hours required for xenon concentration to reach a peak after a trip. This value is dependent upon the previous power history of the reactor and this information was not given. As such this response should be deleted since it does not elicit a specific response.

2. Response (c) assumed a 0-50% STEP power increase. This is an unrealistic occurrence and is in direct conflict with procedural guidance on power rise rates and requires a student to retain/analyze a situation in conflict with his job requirements.

We request this response be deleted from the exam.

EXAMINER RESPONSE 5.06: The examiner partially agrees and allowed full credit for part (a) if the answer given was 5 or 10 hours. The examiner realizes that instantaneous step power changes are not normally planned or desired. For the purposes of demonstrating the affects of xenon behavior, it is commonplace to postulate such a power change due to their more simplistic nature. No changes were made to the exam in this regard.

QUESTION 5.12: This question addresses the effects of boron concentration increasing upon moderator temperature coefficient at low primary coolant temperature. The answer on the key was "water's density does not change much at low temperatures."

COMMENT: The statement of the question is so non-specific that no specific response is elicited. The answer given is consistent with the question, e.g., What quantity is represented by "much" or what value corresponds to "low temperature?" This question ignores the very significant effects of increasing boron concentration while in cold shutdown and the result of a positive moderator coefficient. This question represents a poor choice of topic, no specific response elicited, distractive answer choices (e.g., "parasitic absorption in the moderator") and as such should be deleted from this exam and your exam bank.

EXAMINER RESPONSE 5.12: The question addresses the <u>difference</u> between an increase in boron concentration at low temperatures and an increase in boron concentration at higher temperatures as it affects the moderator temperature coefficient. Since the affects of changing the boron concentration are infinitely variable across the entire moderator temperature spectrum, it would be pointless to identify a specific temperature or a magnitude of change to the moderator density. The reviewer appears to have missed the point of this question entirely. No changes were made to the exam.

QUESTION 5.14: This question asked the student to select from four choices the correct response regarding differential boron worth. Response (c) was, "decreases in a linear relationship with core age." Response (d) was, "decreases as fission products build up in the core."

The answer key gave response (d) as the correct response.

COMMENT: Using Figure 4.2, D. C. COOK UNIT 1, CYCLE 8, DIFFERENTIAL BORON WORTH VS BORON CONCENTRATION (ATTACHED) it can be seen by plotting several boron concentration values (assuming boron concentration is proportional to core age) that the differential boron worth does "decrease" (becomes more negative) and does so in a fashion that very closely approaches a "linear relationship."

We request choice (c) also be allowed as a correct response.

EXAMINER RESPONSE 5.14: The examiner agrees and accepted both answers as correct.

QUESTION 5.19: This question requires a specific numerical calculation of the ratio of flow rate through a three inch versus a two inch diameter line.

COMMENT: The equation(s) required for the solution of this problem is not given on the equation sheet in conflict with ES 202-E GENERAL GUIDANCE POINT 22 that requires equations to either be included in the question or included on the equation sheet. We request that all required equations be stated for calculations of this type either in the body of the question or added to the equation sheet. This comment should be reflected in the grading of this question.

EXAMINER RESPONSE 5.19: The candidate is required to know the relationship between flow and cross sectional area of a pipe. A formula giving this relationship is unnecessary.

QUESTION 5.20: This question requires a specific numerical calculation of the effects of pressure drop on mass flow rate.

COMMENT: The equation(s) required for the solution of this problem is not given on the equation sheet in conflict with ES 202-E GENERAL GUIDANCE POINT 22 that requires equations to either be included in the question or included on the equation sheet. We request that all required equations be stated for calculations of this type either in the body of the question or added to the equation sheet. This comment should be reflected in the grading of this question.

EXAMINER RESPONSE 5.20: The reply to 5.19 is applicable here also.

QUESTION 6.01: This question asked the student to state the condition which initiates the defrost cycle for the ice condenser air handling units.

COMMENT: RFC-DC-1758 (attached) changed the defrost cycle to a time system with a programmed initiation. We request that the answer key be changed to reflect the current system configuration.

EXAMINER RESPONSE 6.01: The examiner agrees and the exam key was corrected.

QUESTION 6.02: This question asked the students to describe the response of a BIT outlet valve if a SI signal were to be received while the valve was closing.

COMMENT: The keyed answer is incorrect. On an SI signal the closing circuit is interrupted and the valve immediately opens. We request the answer key be corrected to reflect actual operation.
Reference: 1-OP-98287-7 attached.

EXAMINER RESPONSE 6.02: The examiner agrees and the exam was corrected.

QUESTION 6.03: This question asked the student to discuss why the Emergency Diesel Generator will start if there is no cooling flow.

COMMENT: Since there are no start permissives in the EDG starting circuitry associated with Essential Cooling Water, we request that either the keyed answer or the following be accepted for full credit.

The EDG will start with no cooling flow because there are no interlocks or permissives from the ESW system preventing the DG start.

EXAMINER RESPONSE 6.03: The examiner agrees and corrected the exam.

QUESTION 6.04: This question asked the student to list the automatic actions associated with the CCW system on a SI or CTS actuation.

COMMENT: The question did not specify the number of responses required in violation of NUREG-1021, ES-202, point 18.

The Spent Fuel Pit Heat Exchanger, the Letdown Heat Exchanger and Boric Acid Evaporator do not actually isolate as stated in the key. CCW Flow is stopped by the closure of either an inlet or outlet valve. We request that this be considered while grading the exam. Reference: Flow Print 1-OP-5135.

EXAMINER RESPONSE 6.04: The examiner agrees. No changes to the exam are necessary.

QUESTION 6.08: This question asked the student to discuss the purpose of the RCP #1 seal bypass valve and when it is used.

COMMENT: The answer key states that the purpose of the #1 Seal bypass valve is to provide additional flow for the pump bearing. The purpose of providing additional flow is to ensure adequate cooling. We request that "to ensure cooling for the pump bearing" be considered correct for full credit.

EXAMINER RESPONSE 6.08: The examiner agrees and the exam was changed.

QUESTION 6.13: This question asked the student to "Briefly describe the operation of the electric hydrogen recombiners located in Containment during a LOCA."

COMMENT: This question is insufficiently clear as to whether a description of the principle of how the recombiners work or how they are operated is required. We request that the following be accepted for full credit as well as the keyed answer.

A recombiner is started by placing its control switch in RUN, adjusting the power supplied to the electric heaters, and monitoring the recombiner temperatures. Reference: NS-15-39.

EXAMINER RESPONSE 6.13: The examiner agrees and the exam was changed.

QUESTION 6.14: This question asked the student to state the conditions or signals which would cause a Steam Line Isolation.

COMMENT: The question did not specify the number of responses required in violation of NUREG-1021, ES-202, point 18.

The question did not specify a unit. We request that responses related to either unit be considered correct for full credit.

EXAMINER RESPONSE 6.14: Since no unit was specified, the candidate is required to include answers for both units.

QUESTION 6.15: This question asked the student to list conditions which would cause the "Ice Condenser Refrigerant Abnormal" Annunciator to come in.

COMMENT: The alarm "ICE COND. REFRIG. SYSTEM ABNORMAL" (Ann. 22 Drop 88 - 1-OP-4042.122.088) does not list alarm conditions. In order to find conditions for the alarm, one of two sources must be consulted. The first is the ICE COND. REFRIGERANT SUB PANEL and its associated Ann. 35 alarm drops and the second is the elementary print. All alarms on Ann. 35 cause the "ICE COND. REFRIG. SYSTEM ABNORMAL;" only four condition are stated in the answer key. The answer key should reflect the fact that all alarms on Ann. 35 cause the plant service alarm or a list of all possible should be included in the key.

We request that all causes of the annunciator alarm condition indicated on OP-12-98297-0 (attached) be considered correct in addition to the keyed answer.

References:
- 1-OHP 4024.122.088
- 1-OHP 4024.135
- OP-12-98297-0 attached.

EXAMINER RESPONSE 6.15: The examiner agrees and the exam was changed even though question/answer was taken directly from the system description.

QUESTION 6.16: This question asked the student to list the input signals to the Variable Gain Unit and to state the purpose of the Unit.

COMMENT: The question did not state the number of responses required for input signals, in violation of NUREG-1021, ES-202, point 18.

The nuclear power signal is "auctioneered" instead of "average" as indicated in the key. The purpose of the Variable Gain Unit is to achieve a "different" response from the rod control system at different power levels instead of "uniform" as keyed. We request that the answer key be changed to reflect the actual inputs and purpose of the Unit. Reference: NS-4, pages 14, 15, and Figure NS-4-1.

EXAMINER RESPONSE 6.16: The examiner agrees and the exam was changed. Candidates should know there are only two inputs, therefore, it is not a violation of NUREG-1021.

QUESTION 7.03: The examiner added one additional correct answer to the key.

QUESTION 7.04: (a) What are the procedural guidelines for the earliest and latest point at which ECC recirculation should be initiated following an accident?

(b) When, following the accident, is hot leg recirculation initiated and why?

COMMENT (A): Part (a) appears to be an open-ended question in that the answer key contains three specific items, whereas the question does not specify that three responses are required for full credit. This is contrary to NUREG-1021, Section ES-202, Item 18, page 5.

We request the answer key be amended to reflect only one of these three items be required for full credit.

COMMENT (B): The answer key for Part (b) is correct for the reference stated; however, reference NS-8, page 40, states, "The purpose of switching to the hot leg flow path is to remove or minimize the buildup of boric acid which plates out on the upper portion of the core."

We request accepting either reference for full credit.

EXAMINER RESPONSE 7.04: The examiner disagrees since the question requires multiple answers including the earliest and latest point at which ECC recirculation should be initiated. The examiner agrees with comment (B) and the exams were graded accordingly.

QUESTION 7.18: The question refers to the use of the reactor vessel head vent.

COMMENT: The question and answer key are worded such that permission to use the reactor vessel head vent must be obtained from three separate groups. This is not the case. OHP-4023.001.015 states the PET and NRC or Advisory Support Group and NRC concurrence are required to operate these vents.

We request the answer key be amended to allow full credit for an answer as per the key or for an answer in which the candidate specifies either PET and NRC or Advisory Support Group and NRC concurrence.

EXAMINER RESPONSE 7.18: The examiner agrees and the exams were graded accordingly.

QUESTION 8.02: The question is on Technical Specification operability requirements.

COMMENT (A): The operability requirement of the ESF fans is satisfied as long as the fan under test was not already inoperable or determined to be inoperable by the surveillance test.

We request that this question allow for a yes or no answer based upon above comments.

COMMENT (B): This question states that governor setting is a Technical Specifications requirement for overspeed. Governor setting by itself is a distraction since the Technical Specification that is of concern is that of time response per the ESFAS Technical Specification 3.3.2.1. The governor setpoint is a procedural requirement. See 7 Sept 84 ENFORCEMENT MEETING with D. C. Cook.

We request that this question be deleted due to its distractive and incorrect nature. Reference: Enforcement Meeting Minutes Dated 11/20/84.

EXAMINER RESPONSE 8.02: The examiner disagrees on both counts. These events were actual reportable occurrences at the licensee's facility. Possibly the plant staff has not been made aware of these fairly recent problems.

QUESTION 8.03:

COMMENTS: This was a commitment and the date for that to be done has not been established.

There have been other occasions that independent verification has been the answer by double verification of clearance permits.

We request that the above comments be reflected in the grading.

References:

- PMI-2110
- PMI-4010, Definition of Independent Verification

EXAMINER RESPONSE 8.03: The examiner agrees and exams were graded accordingly.

QUESTION 8.06:

COMMENT: The answers on this multiple choice question appear to have three (3) answers that may be potentially correct. The first two (2) answers show considerable likeness to material found in Section 3.1.1.1 of PMI-2110. The last answer is quite similar to exceptions found in Attachment #1 to PMI-2110, Part 4.

We request that this question be deleted due to the possibility of multiple answers.

Reference:

PMI-2110, Section 3.1.1.1
Attachment #1, Part 4

EXAMINER RESPONSE 8.06: The examiner disagrees. The wording is similar to that used in the false distractors, but without qualification these distractors are not acceptable answers.

QUESTION 8.10:

COMMENT: OSO.061 specifically addresses Unit Supervisor (US) as the person with the authority to reset an ECCS actuation. This statement is true for situations when a Safety Injection (SI) occurs below the low pressure setpoint for SI. Above this setpoint, the reset actions are directed by procedures. CIA and CIB procedure only require SRO action for reset. The final authority on shift will be the Shift Supervisor (SS). PMI-1010 delineates the command structure such that the SS reports to Production Supervisor and finally to the Operations Superintendent.

We request that the above comments be reflected in the grading of this question.

EXAMINER RESPONSE 8.10: The examiner agrees and accepted answers b or c.

QUESTION 8.11:

COMMENT: The answer required for the question is very confusing. PMSO.034, Rev. 9, is the utility commitment to the one hour and four hour reporting requirements per 10 CFR 50.72. Our procedure lists eight (8) one hour and seven (7) four hour reportable events. Also the reporting requirements of 2 (iv) B of 10 CFR 50.72 reflect that any

20.403 reporting requirements are met by this category of four hour notification. We feel that PMSO.034 guide is the best for an Operator working in the control room.

We request that the number of correct answers should reflect that of PMSO.034.

EXAMINER RESPONSE 8.11: The examiner agrees and the exams were graded accordingly.

QUESTION 8.12:

COMMENT (A): 10 CFR 50.73 Supplemental Information Section Step (g) on REPORTABLE OCCURRENCES supersedes present reportable occurrences of the ADMIN. SECTION 6.0 of Technical Specifications. 10 CFR 50.73 affects Sections 6.9.1.11, 6.9.1.12, and 6.9.1.13, deleting prompt and thirty day notification which includes anomalies. This system of notification is now represented as the LER system per PMI-7030.

We request that the question be deleted or accurately reflect content of 10 CFR 50.73.

EXAMINER RESPONSE 8.12A: The examiner agrees and the exams were graded accordingly.

QUESTION 8.12:

COMMENT (C): We feel that the times as indicated should reflect Technical specification 3.0.2 values:

> "3.0.3 When a Limiting Condition for Operation is not met, except as provided in the associated ACTION requirements, within one hour action shall be initiated to place the unit in a MODE in which the Specification does not apply by placing it, as applicable, in:
>
> 1. At least HOT STANDBY within the next 6 hours,
> 2. At least HOT SHUTDOWN within the following 6 hours, and
> 3. At least COLD SHUTDOWN within the subsequent 24 hours.
>
> Where corrective measures are completed that permit operation under the ACTION requirements, the ACTION may be taken in accordance with the specified time limits as measured from the time of failure to meet the Limiting Condition for Operation. Exceptions to these requirements are stated in the individual Specifications."

We request that answer in key accurately reflect content of Technical Specifications 3.0.3.

EXAMINER RESPONSE 8.12C: The examiner agrees and the exams were graded accordingly.

QUESTION 8.15:

COMMENT (A): The action required in this condition would require the reactor to be tripped per 2-OHP 4022.002.001, Discussion item 2.2. Technical Specifications 3.4.1.1 has action requiring Unit to be in HOT STANDBY within 1 hour.

COMMENT (B): The question is confusing since we are wondering why they can't move. We feel the attached Technical Specifications Clarification #22 might aid in clarifying question and answer.

We request that the above comments be reflected in the grading.

References:

- 2-OHP 4022.002.001
- Technical Specification Clarification #22.

EXAMINER RESPONSE 8.15: The examiner agrees and the exam was graded accordingly.

3. Exit Meeting

On February 28, 1985, the examiners met with plant staff and the resident inspectors to summarize the oral exam results and to discuss other findings or generic weaknesses.

MASTER

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: COOK 1&2

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 85/02/26

EXAMINER: R.R.FERRELL, R.L. Higgins

APPLICANT: _____

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

QUESTION 1.01 (1.00)

Which of the following statements is CORRECT concerning the inverse multiplication plot?

(a) The vertical axis is the initial count rate and the horizontal axis is the final count rate.

(b) The vertical axis is the initial count rate divided by the final count rate and the horizontal axis is control rod reactivity.

(c) The vertical axis is control rod reactivity and the horizontal axis is the final count rate divided by the initial count rate.

(d) The vertical axis is the final count rate divided by the initial count rate and the horizontal axis is control rod reactivity.

QUESTION 1.02 (1.00)

Choose the CORRECT response. With a startup rate of 1 decade per minute, reactor power will double approximately every ___ seconds.

(a) 9

(b) 18

(c) 27

(d) 54

QUESTION 1.03 (1.00)

Which of the following statements about reactivity is CORRECT?

(a) Reactivity is the fractional change in neutron population per generation.

(b) Reactivity is the ratio of the number of neutrons in the present generation divided by the number of neutrons in the preceding generation.

(c) Reactivity exactly equal to one means that the reactor is critical.

(d) Reactivity and the excess multiplication factor can be used interchangeably since they mean the same thing.

QUESTION 1.04 (1.00)

Choose the CORRECT response. As boron concentration increases:

(a) MTC becomes less negative due to the increased neutron leakage.

(b) MTC becomes more negative due to the increased neutron leakage.

(c) MTC becomes less negative due to the increased neutron absorption in the reactor coolant.

(d) MTC becomes more negative due to the increased neutron absorption in the reactor coolant.

QUESTION 1.05 (1.00)

Choose the CORRECT response. The doppler coefficient:

(a) and the power coefficient can be used interchangeably because they mean the same thing.

(b) as a function of power becomes more negative at EOL.

(c) becomes less negative at higher power.

(d) exists because neutrons with energies corresponding to the resonant peak are more likely to be absorbed as the fuel temperature increases.

QUESTION 1.06 (1.00)

Choose the CORRECT response. Control rod worth:

(a) increases as boron concentration increases.

(b) increases as moderator temperature increases.

(c) increases as relative neutron flux decreases.

(d) increases as fission products buildup.

QUESTION 1.07 (1.00)

Choose the CORRECT response. Violation of the rod insertion limit will:

(a) increase the possibility of developing a positive MTC.

(b) prevent control rods from possessing sufficient reactivity worth to keep up with the design rate of power decrease.

(c) preclude an immediate return to full power from a lower power level because of insufficient inserted rod worth.

(d) increase the severity of a rod ejection accident.

QUESTION 1.08 (1.00)

Choose the CORRECT response. If the axial flux deviation is excessively negative, it can be returned to the control band by:

(a) withdrawing control rods while borating.

(b) commencing a controlled dilution.

(c) inserting control rods while borating.

(d) placing a deborating demineralizer in service.

QUESTION 1.09 (1.00)

Choose the CORRECT response. Equilibrium samarium reactivity is:

(a) directly proportional to reactor power.

(b) offset by fuel burnup.

(c) independent of reactor power.

(d) dependent on the decay of iodine.

QUESTION 1.10 (1.00)

Choose the CORRECT response. Axial xenon oscillations can be caused by:

(a) an inadvertent boration at full power with all rods out.

(b) rapid reactor startup with an abnormally large negative MTC.

(c) operation of the reactor at very low power levels for long periods of time.

(d) transient power changes requiring control rod movement.

QUESTION 1.11 (1.00)

Choose the CORRECT response. Plutonium 239 reactivity following a reactor trip:

(a) is independent of the power level prior to the trip.

(b) improves the available shutdown margin.

(c) increases because of the beta decay of neptunium 239.

(d) exactly offsets the reactivity changes due to the decay of iodine.

QUESTION 1.12 (1.00)

Choose the CORRECT response. Which of the following actions will cause the actual critical position to be lower than the estimated critical position?

(a) overfeeding the steam generators.

(b) increasing the steam dump pressure setpoint by 30 psi.

(c) underestimating the boron concentration by 5 ppm.

(d) allowing Tave to increase 2°F.

QUESTION 1.13 (1.00)

Choose the CORRECT response. The adequacy of the shutdown margin is determined in mode 1 by ensuring that the:

(a) control bank withdrawl satisfies the rod insertion limitation.

(b) boron concentration exceeds the normalized boron concentration.

(c) MTC is less negative than -3.5×10^{-4} $\Delta K/K/^{\circ}F$.

(d) reactor coolant system average temperature exceeds $551^{\circ}F$.

QUESTION 1.14 (1.00)

Choose the CORRECT response. The Quadrant Power Tilt Ratio limitation is is applicable:

(a) anytime the reactor is in mode 1.

(b) only when one power range channel is inoperable.

(c) only when reactor power is greater than 50%.

(d) only during dropped rod recoveries.

QUESTION 1.15 (1.00)

Choose the CORRECT response. Penalty deviation outside of the AFD target band shall be accumulated of a time basis of:

(a) one minute for each one-half minute of power operation outside of the target band anytime power is 90% or greater.

(b) one-half minute for each one minute of power operation outside of the target band anytime power is below 50%.

(c) one minute for each one minute of power operation outside of the target band anytime power is below 50%.

(d) one minute for each one minute of power operation outside of the target band anytime power is 50% or greater.

QUESTION 1.16 (1.00)

Choose the CORRECT response. Condensate depression:

(a) can lead to condensate pump cavitation if condensate depression is too great.

(b) decreases as hotwell level rises.

(c) reduces Rankine cycle efficiency.

(d) increases as condensate temperature increases.

QUESTION 1.17 (1.00)

Choose the CORRECT response concerning pump shutoff head for a centrifugal pump.

(a) The excessive flow rate which exists at shutoff head will cause vibrations which may result in pump damage.

(b) Pump shutoff head is the pump head which exists at the onset of cavitation.

(c) Centrifugal pumps must not be started at shutoff head to avoid drawing starting current for an excessive amount of time.

(d) At pump shutoff head the resistance to flow is greater than the power which the pump can impart to the fluid.

QUESTION 1.18 (1.00)

Which of the following statements is NOT correct concerning pump runout? (Choose the answer which is NOT RIGHT.)

(a) Abnormally high discharge pressure is one indication of pump runout.

(b) Excessive current in the pump motor is one indication of pump runout.

(c) Failure of the coupling between the pump shaft and the motor shaft is one indication of pump runout.

(d) Available NPSH less than required NPSH is one indication of pump runout.

QUESTION 1.19 (1.00)

Choose the CORRECT response. To increase the volumetric flow rate in a constant volume positive displacement pump:

(a) reduce system resistance to flow.

(b) increase pump speed.

(c) increase net positive suction head.

(d) increase fluid density.

QUESTION 1.20 (1.00)

Choose the CORRECT response. Steam generator shrink occurs due to the:

(a) rapid increase in steam generator pressure when turbine power suddenly increases.

(b) rapid formation of bubbles forcing additional water into the moisture separators.

(c) rapid decrease in first stage pressure on a down-power transient causing a reduced steam generator level setpoint.

(d) rapid increase in steam generator pressure when turbine power suddenly decreases.

QUESTION 1.21 (1.00)

Choose the CORRECT response. If reactor power increases, DNBR will _____; if RCS pressure increases, DNBR will _____.

(a) increase; increase

(b) increase; decrease

(c) decrease; increase

(d) decrease; decrease

QUESTION 1.22 (1.00)

Choose the CORRECT response. Departure from Nucleate Boiling is defined as the point where the:

(a) void fraction is equal to one.

(b) heat transfer mechanism changes from nucleate boiling to single-phase convection.

(c) radiative heat transfer becomes insignificant.

(d) heat transfer rate sustainable with nucleate boiling reaches its maximum.

QUESTION 1.23 (1.00)

Choose the CORRECT response. High energy neutron exposure increases the possibility of brittle fracture of the reactor vessel by increasing the:

(a) nil ductility temperature of the reactor vessel.

(b) plastic deformation of the reactor vessel.

(c) compressive stress on the reactor vessel.

(d) magnitude of the failure stress of the reactor vessel.

QUESTION 1.24 (1.00)

Choose the CORRECT response concerning natural circulation.

(a) Voiding can not occur if the RCS remains greater than 100°F subcooled.

(b) Maintain lower volume air temperature below 60°F to maximize heat transfer from the vessel head region.

(c) Hot leg temperatures near saturation temperature are an indication of void formation.

(d) Delta T between the hot leg and cold leg increasing to a value greater than the full power delta T is an indication that natural circulation has been established.

QUESTION 1.25 (1.00)

Choose the CORRECT response. In order to maintain a 200°F subcooling margin in the RCS when reducing RCS pressure to 1600 psig, steam generator pressure must be reduced to approximately:

(a) 845 psig

(b) 645 psig

(c) 445 psig

(d) 245 psig

QUESTION 2.01 (2.00)

A.What two chemicals are used for oxygen control in the RCS,one at high temperature,the other at low temperature? [1.0]

B.What material is used to control Ph in the primary plant? [0.5]

C.What are the two purposes of the primary mixed bed demineralizers? [0.5]

QUESTION 2.02 (2.00)

Describe the method (flow path control) by which the RCS cooldown rate is controlled by the RHR system. [2.0]

QUESTION 2.03 (3.00)

A.What is the purpose of the No.1 seal bypass valve on the RCP and when is it generally used? [1.0]

B.What is the purpose of the No.2 seal standpipe and where does the water go from the standpipe? [1.0

C.The RCP No.1 seal water return flow to the CVCS is isolated upon an SI actuation. What provision is made for maintaining seal leakoff after the isolation valves close? [1.0]

QUESTION 2.04 (1.00)

List four (4) automatic actions that occur in the Main Feedwater System upon receipt of an ESF actuation signal. [1.0]

QUESTION 2.05 (1.00)

State the purpose of the Auxiliary Feedwater Pump Emergency Leakoff Lines and explain how they function in your answer. [1.0]

QUESTION 2.06 (2.00)

On a LOCA where pressure is decreasing at a rate of 100 PSIG/min, assuming an initial pressure of 2235 PSIG, answer the following:

1. List the sequence and pressure that components will start injecting water into the RCS. [1.0]
2. What realignment of these injection systems will automatically be performed upon receipt of an ESF signal? [1.0]

QUESTION 2.07 (1.00)

Describe how leakage is detected from the Spent Fuel Pit. [1.0]

QUESTION 2.08 (.75)

List three (3) conditions that can trip the Diesel Generator when it is supplying power to the emergency bus following a blackout or SI. [0.75]

QUESTION 2.09 (2.25)

Explain the function of the following manipulator crane interlock bypass switches:

1. Bridge Reverse Interlock Bypass Switch [0.75]
2. Bridge Forward Interlock Bypass Switch [0.75]
3. Trolley Bypass Interlock Switch [0.75]

[2.25]

QUESTION 2.10 (.75)

List three (3) functions of the Hold-up Tank Recirculation Pump. [0.75]

QUESTION 2.11 (1.00)

A. What is the limit on letdown flow in the CVCS system per the system description? [0.5]
B. Why is this limit imposed? [0.5]

QUESTION 2.12 (1.50)

The pressurizer safety lines have a loop seal in the lines off the pressurizer. Answer the following:

1. What is the purpose of this seal? [0.75]
2. How is it formed and maintained? [0.75]

QUESTION 2.13 (1.00)

Answer the following TRUE or FALSE:

A. During normal operation, most of the gas processed by the gaseous waste system is cover gas from the CVCS Holdup Tanks. [T or F] [0.25]
B. The gaseous waste disposal system is normally aligned such that one tank is being filled, another tank is selected as the standby tank, and a third tank is supplying cover gas to the CVCS Holdup Tanks. [T or F] [0.25]
C. The Spent Resin in the Spent Resin Storage Tank cannot be stored more than one (1) year to prevent the possibility of resin agglomeration (becoming a cluster). [T or F] [0.25]
D. A trip valve (RRV) is installed in the waste gas release line that the operator must close upon receipt of a high radiation alarm from Rad Monitor R-26 (VRA-315) installed in the vent stack. [T or F] [0.25]

QUESTION 2.14 (1.25)

What is the purpose of the Containment Spray System Eductors? Briefly explain their operation in your answer. [1.25]

QUESTION 2.15 (1.50)

Answer the following True or False:

A. Labyrinth seals are installed on the gas-side of the oil seals to prevent oil from flowing along the shaft into the generator seals. (T or F)
B. The stator contains the generator field coils. (T or F)
C. An emergency seal oil pump is installed in series with the main seal oil pump to supply oil to the generator oil seals. (T or F)
D. Fans are mounted at each end of the rotor to circulate the generators atmosphere for cooling. (T or F)
E. The voltage Regulator Selector Switch is a 3 position switch (on, off, test). (T or F) [.03 ea]

QUESTION 2.16 (1.00)

In the normal procedure for RCS degassing, the precautions state that the VCT pressure must be maintained between 15 and 50 psig. Explain why. [1.0]

QUESTION 2.17 (1.00)

Briefly describe the operation of the electric hydrogen recombiners located in containment during a LOCA. [1.0]

QUESTION 2.18 (1.00)

Describe the operation of the Main Turbine Turning Gear and how the turbine is placed on the gear. [1.0]

3. INSTRUMENTS AND CONTROLS

QUESTION 3.01 (1.00)

What is the purpose of the Diesel Generator HEA Lockout Relay Switch? [1.0]

QUESTION 3.02 (1.50)

What actuates the following reactor protection actions (include setpoints and coincidence):

A. Steam Line Isolation [0.75]
B. Containment Spray [0.75]

QUESTION 3.03 (1.00)

List 4 conditions that will actuate the 'Ice Condenser Refrigeration System Abnormal' annunciator. [1.0]

QUESTION 3.04 (2.25)

ASSUME CONTROLLING CHANNEL.

At 100% power with all control systems in auto, a pressurizer level channel fails low. Answer the following questions assuming no operator action. [2.25]

A. What happens to charging flow? [0.50]
B. What happens to actual level? [0.50]
C. Will the Rx trip? If so, on what? [0.75]
D. What happens to VCT level during this transient? [0.50]

QUESTION 3.05 (1.25)

A. What could cause the 'Regenerative Heat Exchanger Letdown Temperature High' annunciator to actuate? [.75]
B. What action can the operator take to correct the alarm and what would his immediate actions be? [0.5]

QUESTION 3.06 (1.00)

List 5 functions performed by Tave. [1.00]

QUESTION 3.07 (1.50)

A. Give two indications for detecting RCS leakage into the Component Cooling Water System. [1.0]

B. What automatic action will occur to contain any radioactivity? [.5]

QUESTION 3.08 (1.75)

A. The Automatic Rod Control System utilizes a variable gain unit. Answer the following:
   1. What is the purpose of the unit? [0.5]
   2. What are the inputs to the unit? [0.5]

B. Give the rod speeds for the following temperature deviations:
   1. 1.5 degrees F
   2. 2.0 " "
   3. 6.0 " "

[0.75] [0.25 ea.]

QUESTION 3.09 (2.25)

CLARIFIED - ALL SYSTEMS IN AUTO (ROD CONTROL, PZR LEVEL etc

For the following questions, assume all control systems are in auto and no operator action is taken.

A. What will be pressurizer level be in two hours following a Th instrument failing high at 25% power? Explain your answer. [0.75]

B. List three (3) indications the operator has to determine if a pressurizer pressure channel has failed high. [0.75]

C. List three (3) indications the operator has if the same pressure channel failed low. [0.75]

QUESTION 3.10 (1.00)

List 4 excore nuclear instrumentation Rx trips with coincidence for each. [1.00]

QUESTION 3.11 (1.00)

Assuming the plant is operating at 50% power with all systems in auto when power range channel N41 lower detector fails high. How will it immediately affect the following:

A.Control Rods
B.Overpower Delta-T setpoint
C.Steam Dump system
D.Indicated Axial Flux Difference [0.25 ea.]

QUESTION 3.12 (1.75)

A.What type of detectors are used at D.C.Cook to measure reactor power in the source,intermediate,and power ranges. [0.75]
B.Why isn't gamma compensation necessary in the power range? [0.5]
C.How does the operator know when an intermediate range channel is under compensated? [0.5]

QUESTION 3.13 (1.00)

List the 5 interlocks that will prevent the operator from withdrawing the rods when in manual. [1.0]

QUESTION 3.14 (2.00)

A.What interlocks are associated with the Steam Dump System? Include the purpose of each in your answer. [.75]

B.Explain the various operating modes of the Steam Dump System. [.75]

C.Per the D.C.Cook normal operating procedures, when is each mode used? [0.5]

QUESTION 3.15 (1.00)

Describe the operation of the following:
A.Control Rod Group Position Indication [0.5]
B.Control Rod Individual Rod Position Indication. [0.5]

3. INSTRUMENTS AND CONTROLS

QUESTION 3.16 (1.75)

A.List 4 inputs to Steam Generator Feedwater Control System. [1.0]

B.List 3 inputs to Feedpump Speed Control System [0.75]

QUESTION 3.17 (1.00)

What is the purpose of the switch in the control room associated with the PORV low pressure protection channels? Explain the purpose of the two positions in your answer. [1.00]

QUESTION 3.18 (1.00)

How are the Pressurizer Power Operated Relief Valves prevented from depressurizing the RCS on a single sensor failure? [1.00]

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

QUESTION 4.01 (1.50)

A.State the Federal (10CFR20) Radiation exposure limits indicated below:
1._____REM per Quarter,Whole Body [0.25]
2._____REM per Quarter,Hands and forearms [0.25]
3._____REM per Quarter,skin [0.25]

B.What types of radiation monitors must a person carry when entering a radiation controlled area? [0.75]

QUESTION 4.02 (2.00)

After a load rejection that has not caused a Rx trip, list 4 immediate actions that must be taken by the operator. [2.0]

QUESTION 4.03 (1.25)

Assuming the Reactor is at 100% power with all systems in auto.Will loss of the following cause the Rx to be tripped (automatically or manually)? Answer each with YES or NO. [1.25]

A.One condenser Circulating Water Pump trips
B.One Main Feedwater Pump trips
C.One dropped rod
D.Two Heater Drain Pumps trip
E.One Reactor Coolant Pump trips [0.25 ea.]

QUESTION 4.04 (1.00)

A.Are you,as an RO,permitted to issue a caution (yellow) tag for equipment under your control? [0.5]
B.Can you authorize removal of a caution tag from equipment under your control? [0.5]

QUESTION 4.05 (1.75)

What are the 7 shift turnover items that both the oncoming Console Operator and Panel Operator (both RO's) must accomplish per OHI-4012,"Conduct of Operations (Shift Turnover)" prior to assuming the shift? [1.75]

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

QUESTION 4.06 (2.00)

List 4 sources of reactivity changes that must be considered in an Estimate of Critical Conditions Procedure, 1-OHP 4021.001.011, "Determination of Critical Conditions". [2.0]

QUESTION 4.07 (2.50)

Per 1-OHP 1023.001.004,"Steam Generator Tube Rupture":

A. What three rad monitors will indicate a tube rupture? (either name or number acceptable) [0.75]

B. After verifying that all automatic actions have occured, list the manual actions that must be performed by the operator. [1.0]

C. If you discover that all Aux Feedwater Pumps are operating and you have not determined the faulted SG, what actions are you required to take? [0.75]

QUESTION 4.08 (1.75)

Per 1-OHP 4023.001.008,"Natural Circulation Procedure",answer the following

A. What is the reason for the immediate closure of the #1 seal leakoff valve if a RCP has lost seal injection flow and cooling water to the Thermal Barrier Hx. [0.5]

B. Assuming that the P-250 computer is not operating, what three temperature indications are you directed to utilize in the control room. [0.75]

C. While performing a depressurization following cooldown,you notice a rapid increase in pressurizer level. What is this an indication of? [0.5]

QUESTION 4.09 (1.00)

What RCS pressure and temperature limits are imposed when the RHR system is placed in/out of service? (unit 1 only) [1.0]

QUESTION 4.10 (2.00)

A. During a plant heatup, using procedure 1-OHP 4021.001.001, when must the Shutdown Margin be verified? [1.0]

B. What action is required if the SDM does not meet the limit? [1.0]

QUESTION 4.11 (1.00)

What is the minimum number of Nuclear Instruments that must be operable prior to commencing a Reactor Startup per Tech Specs. [1.00]

QUESTION 4.12 (.75)

Per procedure 1-OHP 4023.001.009, "Loss of Reactor Coolant", what is the RCP tripping criteria? [.75]

QUESTION 4.13 (1.50)

A. Give 3 symptoms of a leaking Pressurizer Power Operated Relief Vlv. [.75]

B. What immediate operator actions are necessary to correct the problem? [.75]

QUESTION 4.14 (1.00)

Per 02-OHP 4022.005.002, "Emergency Boration", list 4 conditions where the RO must commence Emergency Boration. [1.0]

QUESTION 4.15 (2.00)

Concerning a normal reactor startup, answer the following TRUE or FALSE.

A. All 4 RCP's must be operating when Tave is greater than 541 degrees F.

B. During a reactor startup, 3 licensed personnel must be in the control room at all times, one of which must be a SRO.

C. If Tave drops to less than 541 degrees F when the Rx is critical, it must be restored within 15 min or the plant placed in Hot Standby in the next 15 min.

D. Pressurizer Spray must not be initiated with a temperature difference greater than 320 degrees F.

E. Criticality achieved at 1000PCM below the ECP and 500 PCM above the ECP is allowable by procedure. [.40 ea.][2.0]

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

QUESTION 4.16 (2.00)

A. What is the purpose of changing over from cold leg recirculation after a LOCA to the hot leg recirculation phase? [1.0]

B. Under what conditions might RHR spray be required in containment? [1.0]

EQUATION SHEET

$f = ma$

$v = s/t$

Cycle efficiency = (Network out)/(Energy in)

$w = mg$

$s = V_o t + 1/2\ at^2$

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$ $\quad A = A_o e^{-\lambda t}$

$PE = mgh$

$w = \theta/t$

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

$V_f = V_o + at$

$t_{1/2}^{eff} = \dfrac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$W = \nu\ \Delta P$

$\Delta E = 931\ \Delta m$

$I = I_o e^{-\Sigma x}$

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

$\dot{Q} = UA\Delta t$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$Pwr = W_f \Delta h$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$P = P_o 10^{sur(t)}$

$P = P_o e^{t/T}$

$SUR = 26.06/T$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$SUR = 26\rho/\ell^* + (\beta - \rho)\bar{T}$

$M = 1/(1 - K_{eff}) = CR_1/CR_o$

$M = (1 - K_{effo})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-5}$ seconds

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

$T = (\ell^*/\rho) + [(\beta - \rho)/\lambda\rho]$

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\lambda\rho)$

$\rho = (K_{eff} - 1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [(\ell^*/(T\ K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$

$R/hr = (0.5\ CE)/d^2$(meters)

$R/hr = 6\ CE/d^2$ (feet)

$P = (\Sigma\phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
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 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 $lbf/in.^2$

Miscellaneous Conversions

1 curie = 3.7×10^{10} dps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

Table 1. Saturated Steam: Temperature Table

Temp Fahr t	Abs Press Lb per Sq In. p	Specific Volume Sat. Liquid v_f	Specific Volume Evap v_{fg}	Specific Volume Sat. Vapor v_g	Enthalpy Sat. Liquid h_f	Enthalpy Evap h_{fg}	Enthalpy Sat. Vapor h_g	Entropy Sat. Liquid s_f	Entropy Evap s_{fg}	Entropy Sat. Vapor s_g	Temp Fahr t
32.0*	0.08859	0.016022	3304.7	3304.7	-0.0179	1075.5	1075.5	0.0000	2.1873	2.1873	32.0*
34.0	0.09600	0.016021	3061.9	3061.9	1.996	1074.4	1076.4	0.0041	2.1762	2.1802	34.0
36.0	0.10395	0.016020	2839.0	2839.0	4.008	1073.2	1077.2	0.0081	2.1651	2.1732	36.0
38.0	0.11249	0.016019	2634.1	2634.2	6.018	1072.1	1078.1	0.0122	2.1541	2.1663	38.0
40.0	0.12163	0.016019	2445.8	2445.8	8.027	1071.0	1079.0	0.0162	2.1432	2.1594	40.0
42.0	0.13143	0.016019	2272.4	2272.4	10.035	1069.8	1079.9	0.0202	2.1325	2.1527	42.0
44.0	0.14192	0.016019	2112.8	2112.8	12.041	1068.7	1080.7	0.0242	2.1217	2.1459	44.0
46.0	0.15314	0.016020	1965.7	1965.7	14.047	1067.6	1081.6	0.0282	2.1111	2.1393	46.0
48.0	0.16514	0.016021	1830.0	1830.0	16.051	1066.4	1082.5	0.0321	2.1006	2.1327	48.0
50.0	0.17796	0.016023	1704.8	1704.8	18.054	1065.3	1083.4	0.0361	2.0901	2.1262	50.0
52.0	0.19165	0.016024	1589.2	1589.2	20.057	1064.2	1084.2	0.0400	2.0798	2.1197	52.0
54.0	0.20625	0.016026	1482.4	1482.4	22.058	1063.1	1085.1	0.0439	2.0695	2.1134	54.0
56.0	0.22183	0.016028	1383.6	1383.6	24.059	1061.9	1086.0	0.0478	2.0593	2.1070	56.0
58.0	0.23843	0.016031	1292.2	1292.2	26.060	1060.8	1086.9	0.0516	2.0491	2.1008	58.0
60.0	0.25611	0.016033	1207.6	1207.6	28.060	1059.7	1087.7	0.0555	2.0391	2.0946	60.0
62.0	0.27494	0.016036	1129.2	1129.2	30.059	1058.5	1088.6	0.0593	2.0291	2.0885	62.0
64.0	0.29497	0.016039	1056.5	1056.5	32.058	1057.4	1089.5	0.0632	2.0192	2.0824	64.0
66.0	0.31626	0.016043	989.0	989.1	34.056	1056.3	1090.4	0.0670	2.0094	2.0764	66.0
68.0	0.33889	0.016046	926.5	926.5	36.054	1055.2	1091.2	0.0708	1.9996	2.0704	68.0
70.0	0.36292	0.016050	868.3	868.4	38.052	1054.0	1092.1	0.0745	1.9900	2.0645	70.0
72.0	0.38844	0.016054	814.3	814.3	40.049	1052.9	1093.0	0.0783	1.9804	2.0587	72.0
74.0	0.41550	0.016058	764.1	764.1	42.046	1051.8	1093.8	0.0821	1.9708	2.0529	74.0
76.0	0.44420	0.016063	717.4	717.4	44.043	1050.7	1094.7	0.0858	1.9614	2.0472	76.0
78.0	0.47461	0.016067	673.8	673.9	46.040	1049.5	1095.6	0.0895	1.9520	2.0415	78.0
80.0	0.50683	0.016072	633.3	633.3	48.037	1048.4	1096.4	0.0932	1.9426	2.0359	80.0
82.0	0.54093	0.016077	595.5	595.5	50.033	1047.3	1097.3	0.0969	1.9334	2.0303	82.0
84.0	0.57702	0.016082	560.3	560.3	52.029	1046.1	1098.2	0.1006	1.9242	2.0248	84.0
86.0	0.61518	0.016087	527.5	527.5	54.026	1045.0	1099.0	0.1043	1.9151	2.0193	86.0
88.0	0.65551	0.016093	496.8	496.8	56.022	1043.9	1099.9	0.1079	1.9060	2.0139	88.0
90.0	0.69813	0.016099	468.1	468.1	58.018	1042.7	1100.8	0.1115	1.8970	2.0086	90.0
92.0	0.74313	0.016105	441.3	441.3	60.014	1041.6	1101.6	0.1152	1.8881	2.0033	92.0
94.0	0.79062	0.016111	416.3	416.3	62.010	1040.5	1102.5	0.1188	1.8792	1.9980	94.0
96.0	0.84072	0.016117	392.8	392.9	64.006	1039.3	1103.3	0.1224	1.8704	1.9928	96.0
98.0	0.89356	0.016123	370.9	370.9	66.003	1038.2	1104.2	0.1260	1.8617	1.9876	98.0
100.0	0.94924	0.016130	350.4	350.4	67.999	1037.1	1105.1	0.1295	1.8530	1.9825	100.0
102.0	1.00789	0.016137	331.1	331.1	69.995	1035.9	1105.9	0.1331	1.8444	1.9775	102.0
104.0	1.06965	0.016144	313.1	313.1	71.992	1034.8	1106.8	0.1366	1.8358	1.9725	104.0
106.0	1.1347	0.016151	296.16	296.18	73.99	1033.6	1107.6	0.1402	1.8273	1.9675	106.0
108.0	1.2030	0.016158	280.28	280.30	75.98	1032.5	1108.5	0.1437	1.8188	1.9626	108.0
110.0	1.2750	0.016165	265.37	265.39	77.98	1031.4	1109.3	0.1472	1.8105	1.9577	110.0
112.0	1.3505	0.016173	251.37	251.38	79.98	1030.2	1110.2	0.1507	1.8021	1.9528	112.0
114.0	1.4299	0.016180	238.21	238.22	81.97	1029.1	1111.0	0.1542	1.7938	1.9480	114.0
116.0	1.5133	0.016188	225.84	225.85	83.97	1027.9	1111.9	0.1577	1.7856	1.9433	116.0
118.0	1.6009	0.016196	214.20	214.21	85.97	1026.8	1112.7	0.1611	1.7774	1.9386	118.0
120.0	1.6927	0.016204	203.25	203.26	87.97	1025.6	1113.6	0.1646	1.7693	1.9339	120.0
122.0	1.7891	0.016213	192.94	192.95	89.96	1024.5	1114.4	0.1680	1.7613	1.9293	122.0
124.0	1.8901	0.016221	183.23	183.24	91.96	1023.3	1115.3	0.1715	1.7533	1.9247	124.0
126.0	1.9959	0.016229	174.08	174.09	93.96	1022.2	1116.1	0.1749	1.7453	1.9202	126.0
128.0	2.1068	0.016238	165.45	165.47	95.96	1021.0	1117.0	0.1783	1.7374	1.9157	128.0
130.0	2.2230	0.016247	157.32	157.33	97.96	1019.8	1117.8	0.1817	1.7295	1.9112	130.0
132.0	2.3445	0.016256	149.64	149.66	99.95	1018.7	1118.6	0.1851	1.7217	1.9068	132.0
134.0	2.4717	0.016265	142.40	142.41	101.95	1017.5	1119.5	0.1884	1.7140	1.9024	134.0
136.0	2.6047	0.016274	135.55	135.57	103.95	1016.4	1120.3	0.1918	1.7063	1.8980	136.0
138.0	2.7438	0.016284	129.09	129.11	105.95	1015.2	1121.1	0.1951	1.6986	1.8937	138.0
140.0	2.8892	0.016293	122.98	123.00	107.95	1014.0	1122.0	0.1985	1.6910	1.8895	140.0
142.0	3.0411	0.016303	117.21	117.22	109.95	1012.9	1122.8	0.2018	1.6834	1.8852	142.0
144.0	3.1997	0.016312	111.74	111.76	111.95	1011.7	1123.6	0.2051	1.6759	1.8810	144.0
146.0	3.3653	0.016322	106.58	106.59	113.95	1010.5	1124.5	0.2084	1.6684	1.8769	146.0
148.0	3.5381	0.016332	101.68	101.70	115.95	1009.3	1125.3	0.2117	1.6610	1.8727	148.0
150.0	3.7184	0.016343	97.05	97.07	117.95	1008.2	1126.1	0.2150	1.6536	1.8686	150.0
152.0	3.9065	0.016353	92.66	92.68	119.95	1007.0	1126.9	0.2183	1.6463	1.8646	152.0
154.0	4.1025	0.016363	88.50	88.52	121.95	1005.8	1127.7	0.2216	1.6390	1.8606	154.0
156.0	4.3068	0.016374	84.56	84.57	123.95	1004.6	1128.6	0.2248	1.6318	1.8566	156.0
158.0	4.5197	0.016384	80.82	80.83	125.96	1003.4	1129.4	0.2281	1.6245	1.8526	158.0
160.0	4.7414	0.016395	77.27	77.29	127.96	1002.2	1130.2	0.2313	1.6174	1.8487	160.0
162.0	4.9722	0.016406	73.90	73.92	129.96	1001.0	1131.0	0.2345	1.6103	1.8448	162.0
164.0	5.2124	0.016417	70.70	70.72	131.96	999.8	1131.8	0.2377	1.6032	1.8409	164.0
166.0	5.4623	0.016428	67.67	67.68	133.97	998.6	1132.6	0.2409	1.5961	1.8371	166.0
168.0	5.7223	0.016440	64.78	64.80	135.97	997.4	1133.4	0.2441	1.5892	1.8333	168.0
170.0	5.9926	0.016451	62.04	62.06	137.97	996.2	1134.2	0.2473	1.5822	1.8295	170.0
172.0	6.2736	0.016463	59.43	59.45	139.98	995.0	1135.0	0.2505	1.5753	1.8258	172.0
174.0	6.5656	0.016474	56.95	56.97	141.98	993.8	1135.8	0.2537	1.5684	1.8221	174.0
176.0	6.8690	0.016486	54.59	54.61	143.99	992.6	1136.6	0.2568	1.5616	1.8184	176.0
178.0	7.1840	0.016498	52.35	52.36	145.99	991.4	1137.4	0.2600	1.5548	1.8147	178.0

*The states shown are meta stable

Table 1. Saturated Steam: Temperature Table—*Continued*

Temp Fahr t	Abs Press Lb per Sq In p	Specific Volume Sat Liquid v_f	Evap v_{fg}	Sat Vapor v_g	Enthalpy Sat Liquid h_f	Evap h_{fg}	Sat Vapor h_g	Entropy Sat Liquid s_f	Evap s_{fg}	Sat Vapor s_g	Temp Fahr t
188.0	7.5110	0.016510	50.21	50.22	148.00	990.2	1138.2	0.2631	1.5480	1.8111	188.0
192.0	7.850	0.016522	48.172	48.189	150.01	989.0	1139.0	0.2662	1.5413	1.8075	192.0
196.0	8.203	0.016534	46.232	46.249	152.01	987.8	1139.8	0.2694	1.5346	1.8040	196.0
200.0	8.568	0.016547	44.383	44.400	154.02	986.5	1140.5	0.2725	1.5279	1.8004	200.0
204.0	8.947	0.016559	42.621	42.638	156.03	985.3	1141.3	0.2756	1.5213	1.7969	204.0
208.0	9.340	0.016572	40.941	40.957	158.04	984.1	1142.1	0.2787	1.5148	1.7934	208.0
212.0	9.747	0.016585	39.337	39.354	160.05	982.8	1142.9	0.2818	1.5082	1.7900	212.0
216.0	10.168	0.016598	37.808	37.824	162.05	981.6	1143.7	0.2848	1.5017	1.7865	216.0
220.0	10.605	0.016611	36.348	36.364	164.06	980.4	1144.4	0.2879	1.4952	1.7831	220.0
224.0	11.058	0.016624	34.954	34.970	166.08	979.1	1145.2	0.2910	1.4888	1.7798	224.0
228.0	11.526	0.016637	33.622	33.639	168.09	977.9	1146.0	0.2940	1.4824	1.7764	228.0
232.0	12.512	0.016664	31.135	31.151	172.11	975.4	1147.5	0.3001	1.4697	1.7698	232.0
236.0	13.568	0.016691	28.862	28.878	176.14	972.8	1149.0	0.3061	1.4571	1.7632	236.0
240.0	14.696	0.016719	26.782	26.799	180.17	970.3	1150.5	0.3121	1.4447	1.7568	240.0
244.0	15.901	0.016747	24.878	24.894	184.20	967.8	1152.0	0.3181	1.4323	1.7505	244.0
248.0	17.186	0.016775	23.131	23.148	188.23	965.2	1153.4	0.3241	1.4201	1.7442	248.0
252.0	18.556	0.016805	21.529	21.545	192.27	962.6	1154.9	0.3300	1.4081	1.7380	252.0
256.0	20.015	0.016834	20.056	20.073	196.31	960.0	1156.3	0.3359	1.3961	1.7320	256.0
260.0	21.567	0.016864	18.701	18.718	200.35	957.4	1157.8	0.3417	1.3842	1.7260	260.0
264.0	23.216	0.016895	17.454	17.471	204.40	954.8	1159.2	0.3476	1.3725	1.7201	264.0
268.0	24.968	0.016926	16.304	16.321	208.45	952.1	1160.6	0.3533	1.3609	1.7142	268.0
272.0	26.826	0.016958	15.243	15.260	212.50	949.5	1162.0	0.3591	1.3494	1.7085	272.0
276.0	28.796	0.016990	14.264	14.281	216.56	946.8	1163.4	0.3649	1.3379	1.7028	276.0
280.0	30.883	0.017022	13.358	13.375	220.62	944.1	1164.7	0.3706	1.3266	1.6972	280.0
284.0	33.091	0.017055	12.520	12.538	224.69	941.4	1166.1	0.3763	1.3154	1.6917	284.0
288.0	35.427	0.017089	11.745	11.762	228.76	938.6	1167.4	0.3819	1.3043	1.6862	288.0
292.0	37.894	0.017123	11.025	11.042	232.83	935.9	1168.7	0.3876	1.2933	1.6808	292.0
296.0	40.500	0.017157	10.358	10.375	236.91	933.1	1170.0	0.3932	1.2823	1.6755	296.0
300.0	43.249	0.017193	9.738	9.755	240.99	930.3	1171.3	0.3987	1.2715	1.6702	300.0
304.0	46.147	0.017228	9.162	9.180	245.08	927.5	1172.5	0.4043	1.2607	1.6650	304.0
308.0	49.200	0.017264	8.627	8.644	249.17	924.6	1173.8	0.4098	1.2501	1.6599	308.0
312.0	52.414	0.01730	8.1280	8.1453	253.3	921.7	1175.0	0.4154	1.2395	1.6548	312.0
316.0	55.795	0.01734	7.6634	7.6807	257.4	918.8	1176.2	0.4208	1.2290	1.6498	316.0
320.0	59.350	0.01738	7.2301	7.2475	261.5	915.9	1177.4	0.4263	1.2186	1.6449	320.0
324.0	63.084	0.01741	6.8259	6.8433	265.6	913.0	1178.6	0.4317	1.2082	1.6400	324.0
328.0	67.005	0.01745	6.4483	6.4658	269.7	910.0	1179.7	0.4372	1.1979	1.6351	328.0
332.0	71.119	0.01749	6.0955	6.1130	273.8	907.0	1180.9	0.4426	1.1877	1.6303	332.0
336.0	75.433	0.01753	5.7655	5.7830	278.0	904.0	1182.0	0.4479	1.1776	1.6256	336.0
340.0	79.953	0.01757	5.4566	5.4742	282.1	901.0	1183.1	0.4533	1.1676	1.6209	340.0
344.0	84.688	0.01761	5.1673	5.1849	286.3	897.9	1184.1	0.4586	1.1576	1.6162	344.0
348.0	89.643	0.01766	4.8961	4.9138	290.4	894.8	1185.2	0.4640	1.1477	1.6116	348.0
352.0	94.826	0.01770	4.6418	4.6595	294.6	891.6	1186.2	0.4692	1.1378	1.6071	352.0
356.0	100.245	0.01774	4.4030	4.4208	298.7	888.5	1187.2	0.4745	1.1280	1.6025	356.0
360.0	105.907	0.01779	4.1788	4.1966	302.9	885.3	1188.2	0.4798	1.1183	1.5981	360.0
364.0	111.820	0.01783	3.9681	3.9859	307.1	882.1	1189.1	0.4850	1.1086	1.5936	364.0
368.0	117.992	0.01787	3.7699	3.7878	311.3	878.8	1190.1	0.4902	1.0990	1.5892	368.0
372.0	124.430	0.01792	3.5834	3.6013	315.5	875.5	1191.0	0.4954	1.0894	1.5849	372.0
376.0	131.142	0.01797	3.4078	3.4258	319.7	872.2	1191.1	0.5006	1.0799	1.5806	376.0
380.0	138.138	0.01801	3.2423	3.2603	323.9	868.9	1192.7	0.5058	1.0705	1.5763	380.0
384.0	145.424	0.01806	3.0863	3.1044	328.1	865.5	1193.6	0.5110	1.0611	1.5721	384.0
388.0	153.010	0.01811	2.9392	2.9573	332.3	862.1	1194.4	0.5161	1.0517	1.5678	388.0
392.0	160.903	0.01816	2.8002	2.8184	336.5	858.6	1195.2	0.5212	1.0424	1.5637	392.0
396.0	169.113	0.01821	2.6691	2.6873	340.8	855.1	1195.9	0.5263	1.0332	1.5595	396.0
400.0	177.648	0.01826	2.5451	2.5633	345.0	851.6	1196.7	0.5314	1.0240	1.5554	400.0
404.0	186.517	0.01831	2.4279	2.4462	349.3	848.1	1197.4	0.5365	1.0148	1.5513	404.0
408.0	195.729	0.01836	2.3170	2.3353	353.6	844.5	1198.0	0.5416	1.0057	1.5473	408.0
412.0	205.294	0.01842	2.2120	2.2304	357.9	840.8	1198.7	0.5466	0.9966	1.5432	412.0
416.0	215.220	0.01847	2.1126	2.1311	362.2	837.2	1199.3	0.5516	0.9876	1.5392	416.0
420.0	225.516	0.01853	2.0184	2.0369	366.5	833.4	1199.9	0.5567	0.9786	1.5353	420.0
424.0	236.193	0.01858	1.9291	1.9477	370.8	829.7	1200.4	0.5617	0.9696	1.5313	424.0
428.0	247.259	0.01864	1.8444	1.8630	375.1	825.9	1201.0	0.5667	0.9607	1.5274	428.0
432.0	258.725	0.01870	1.7640	1.7827	379.4	822.0	1201.5	0.5717	0.9518	1.5234	432.0
436.0	270.600	0.01875	1.6877	1.7064	383.8	818.2	1201.9	0.5766	0.9429	1.5195	436.0
440.0	282.894	0.01881	1.6152	1.6340	388.1	814.2	1202.4	0.5816	0.9341	1.5157	440.0
444.0	295.617	0.01887	1.5463	1.5651	392.5	810.2	1202.8	0.5866	0.9253	1.5118	444.0
448.0	308.780	0.01894	1.4808	1.4997	396.9	806.2	1203.1	0.5915	0.9165	1.5080	448.0
452.0	322.391	0.01900	1.4184	1.4374	401.3	802.2	1203.5	0.5964	0.9077	1.5042	452.0
456.0	336.463	0.01906	1.3591	1.3782	405.7	798.0	1203.7	0.6014	0.8990	1.5004	456.0
460.0	351.00	0.01913	1.30266	1.32179	410.1	793.9	1204.0	0.6063	0.8903	1.4966	460.0
464.0	366.03	0.01919	1.24887	1.26806	414.6	789.7	1204.2	0.6112	0.8816	1.4928	464.0
468.0	381.54	0.01926	1.19761	1.21687	419.0	785.4	1204.4	0.6161	0.8729	1.4890	468.0
472.0	397.56	0.01933	1.14874	1.16806	423.5	781.1	1204.6	0.6210	0.8643	1.4853	472.0
476.0	414.09	0.01940	1.10212	1.12152	428.0	776.7	1204.7	0.6259	0.8557	1.4815	476.0
480.0	431.14	0.01947	1.05764	1.07711	432.5	772.3	1204.8	0.6308	0.8471	1.4778	480.0
484.0	448.73	0.01954	1.01518	1.03472	437.0	767.8	1204.8	0.6356	0.8385	1.4741	484.0

Table 1. Saturated Steam: Temperature Table—*Continued*

Temp Fahr t	Abs Press Lb per Sq In p	Specific Volume Sat Liquid v_f	Specific Volume Evap v_{fg}	Specific Volume Sat Vapor v_g	Enthalpy Sat Liquid h_f	Enthalpy Evap h_{fg}	Enthalpy Sat Vapor h_g	Entropy Sat Liquid s_f	Entropy Evap s_{fg}	Entropy Sat Vapor s_g	Temp Fahr t
488.0	466.87	0.01961	0.97463	0.99424	441.5	763.2	1204.8	0.6405	0.8299	1.4704	488.0
484.0	485.56	0.01969	0.93588	0.95557	446.1	758.6	1204.7	0.6454	0.8213	1.4667	484.0
480.0	504.83	0.01976	0.89885	0.91862	450.7	754.0	1204.6	0.6502	0.8127	1.4629	480.0
476.0	524.67	0.01984	0.86345	0.88329	455.2	749.3	1204.5	0.6551	0.8042	1.4592	476.0
472.0	545.11	0.01992	0.82958	0.84950	459.9	744.5	1204.3	0.6599	0.7956	1.4555	472.0
468.0	566.15	0.02000	0.79716	0.81717	464.5	739.6	1204.1	0.6648	0.7871	1.4518	468.0
464.0	587.81	0.02009	0.76613	0.78622	469.1	734.7	1203.8	0.6696	0.7785	1.4481	464.0
460.0	610.10	0.02017	0.73641	0.75658	473.8	729.7	1203.5	0.6745	0.7700	1.4444	460.0
456.0	633.03	0.02026	0.70794	0.72820	478.5	724.6	1203.1	0.6793	0.7614	1.4407	456.0
452.0	656.61	0.02034	0.68065	0.70100	483.2	719.5	1202.7	0.6842	0.7528	1.4370	452.0
448.0	680.86	0.02043	0.65448	0.67492	487.9	714.3	1202.2	0.6890	0.7443	1.4333	448.0
444.0	705.78	0.02053	0.62938	0.64991	492.7	709.0	1201.7	0.6939	0.7357	1.4296	444.0
440.0	731.40	0.02062	0.60530	0.62592	497.5	703.7	1201.1	0.6987	0.7271	1.4258	440.0
436.0	757.72	0.02072	0.58218	0.60289	502.3	698.2	1200.5	0.7036	0.7185	1.4221	436.0
432.0	784.76	0.02081	0.55997	0.58079	507.1	692.7	1199.8	0.7085	0.7099	1.4183	432.0
428.0	812.53	0.02091	0.53864	0.55956	512.0	687.0	1199.0	0.7133	0.7013	1.4146	428.0
424.0	841.04	0.02102	0.51814	0.53916	516.9	681.3	1198.2	0.7182	0.6926	1.4108	424.0
420.0	870.31	0.02112	0.49843	0.51955	521.8	675.5	1197.3	0.7231	0.6839	1.4070	420.0
416.0	900.34	0.02123	0.47947	0.50070	526.8	669.6	1196.4	0.7280	0.6752	1.4032	416.0
412.0	931.17	0.02134	0.46123	0.48257	531.7	663.6	1195.4	0.7329	0.6665	1.3993	412.0
408.0	962.79	0.02146	0.44367	0.46513	536.8	657.5	1194.3	0.7378	0.6577	1.3954	408.0
404.0	995.22	0.02157	0.42677	0.44834	541.8	651.3	1193.1	0.7427	0.6489	1.3915	404.0
400.0	1028.49	0.02169	0.41048	0.43217	546.9	645.0	1191.9	0.7476	0.6400	1.3876	400.0
396.0	1062.59	0.02182	0.39479	0.41660	552.0	638.5	1190.6	0.7525	0.6311	1.3837	396.0
392.0	1097.55	0.02194	0.37966	0.40160	557.2	632.0	1189.2	0.7575	0.6222	1.3797	392.0
388.0	1133.38	0.02207	0.36507	0.38714	562.4	625.3	1187.7	0.7625	0.6132	1.3757	388.0
384.0	1170.10	0.02221	0.35099	0.37320	567.6	618.5	1186.1	0.7674	0.6041	1.3716	384.0
380.0	1207.72	0.02235	0.33741	0.35975	572.9	611.5	1184.5	0.7725	0.5950	1.3675	380.0
376.0	1246.26	0.02249	0.32429	0.34678	578.3	604.5	1182.7	0.7775	0.5859	1.3634	376.0
372.0	1285.74	0.02264	0.31162	0.33426	583.7	597.2	1180.9	0.7825	0.5766	1.3592	372.0
368.0	1326.17	0.02279	0.29937	0.32216	589.1	589.9	1179.0	0.7876	0.5673	1.3550	368.0
364.0	1367.7	0.02295	0.28753	0.31048	594.6	582.4	1176.9	0.7927	0.5580	1.3507	364.0
360.0	1410.0	0.02311	0.27608	0.29919	600.1	574.7	1174.8	0.7978	0.5485	1.3464	360.0
356.0	1453.3	0.02328	0.26499	0.28827	605.7	566.8	1172.6	0.8030	0.5390	1.3420	356.0
352.0	1497.8	0.02345	0.25425	0.27770	611.4	558.8	1170.2	0.8082	0.5293	1.3375	352.0
348.0	1543.2	0.02364	0.24384	0.26747	617.1	550.6	1167.7	0.8134	0.5196	1.3330	348.0
344.0	1589.7	0.02382	0.23374	0.25757	622.9	542.2	1165.1	0.8187	0.5097	1.3284	344.0
340.0	1637.3	0.02402	0.22394	0.24796	628.8	533.6	1162.4	0.8240	0.4997	1.3238	340.0
336.0	1686.1	0.02422	0.21442	0.23865	634.8	524.7	1159.5	0.8294	0.4896	1.3190	336.0
332.0	1735.9	0.02444	0.20516	0.22960	640.8	515.6	1156.4	0.8348	0.4794	1.3141	332.0
328.0	1786.9	0.02466	0.19615	0.22081	646.9	506.3	1153.2	0.8403	0.4689	1.3092	328.0
324.0	1839.0	0.02489	0.18737	0.21226	653.1	496.6	1149.8	0.8458	0.4583	1.3041	324.0
320.0	1892.4	0.02514	0.17880	0.20394	659.5	486.7	1146.1	0.8514	0.4474	1.2988	320.0
316.0	1947.0	0.02539	0.17044	0.19583	665.9	476.4	1142.2	0.8571	0.4364	1.2934	316.0
312.0	2002.8	0.02566	0.16226	0.18792	672.4	465.7	1138.1	0.8628	0.4251	1.2879	312.0
308.0	2059.9	0.02595	0.15427	0.18021	679.1	454.6	1133.7	0.8686	0.4134	1.2821	308.0
304.0	2118.3	0.02625	0.14644	0.17269	685.9	443.1	1129.0	0.8746	0.4015	1.2761	304.0
300.0	2178.1	0.02657	0.13876	0.16534	692.9	431.1	1124.0	0.8806	0.3893	1.2699	300.0
296.0	2239.2	0.02691	0.13124	0.15816	700.0	418.7	1118.7	0.8868	0.3767	1.2634	296.0
292.0	2301.7	0.02728	0.12387	0.15115	707.4	405.7	1113.1	0.8931	0.3637	1.2567	292.0
288.0	2365.7	0.02768	0.11663	0.14431	714.9	392.1	1107.0	0.8995	0.3502	1.2498	288.0
284.0	2431.1	0.02811	0.10947	0.13757	722.9	377.7	1100.6	0.9064	0.3361	1.2425	284.0
280.0	2498.1	0.02858	0.10229	0.13087	731.5	362.1	1093.5	0.9137	0.3210	1.2347	280.0
276.0	2566.6	0.02911	0.09514	0.12424	740.2	345.7	1085.9	0.9212	0.3054	1.2266	276.0
272.0	2636.8	0.02970	0.08799	0.11769	749.2	328.5	1077.6	0.9287	0.2892	1.2179	272.0
268.0	2708.6	0.03037	0.08080	0.11117	758.5	310.1	1068.5	0.9365	0.2720	1.2086	268.0
264.0	2782.1	0.03114	0.07349	0.10463	768.2	290.2	1058.4	0.9447	0.2537	1.1984	264.0
260.0	2857.4	0.03204	0.06595	0.09799	778.8	268.2	1047.0	0.9535	0.2337	1.1872	260.0
256.0	2934.5	0.03313	0.05797	0.09110	790.5	243.1	1033.6	0.9634	0.2110	1.1744	256.0
252.0	3013.4	0.03455	0.04916	0.08371	804.4	212.8	1017.2	0.9749	0.1841	1.1591	252.0
248.0	3094.3	0.03662	0.03857	0.07519	822.4	172.7	995.2	0.9901	0.1490	1.1390	248.0
244.0	3135.5	0.03824	0.03173	0.06997	835.0	144.7	979.7	1.0006	0.1246	1.1252	244.0
240.0	3177.2	0.04108	0.02192	0.06300	854.2	102.0	956.2	1.0169	0.0876	1.1046	240.0
236.0	3198.3	0.04427	0.01304	0.05730	873.0	61.4	934.4	1.0329	0.0527	1.0856	236.0
235.47*	3208.2	0.05078	0.00000	0.05078	906.0	0.0	906.0	1.0612	0.0000	1.0612	235.47*

*Critical temperature

Table 2: Saturated Steam: Pressure Table

Abs. Press. Lb/Sq. In. p	Temp Fahr t	Specific Volume Sat. Liquid v_f	Specific Volume Evap v_{fg}	Specific Volume Sat. Vapor v_g	Enthalpy Sat. Liquid h_f	Enthalpy Evap h_{fg}	Enthalpy Sat. Vapor h_g	Entropy Sat. Liquid s_f	Entropy Evap s_{fg}	Entropy Sat. Vapor s_g	Abs. Press. Lb/Sq. In. p
0.08865	32.018	0.016022	3302.4	3302.4	0.0003	1075.5	1075.5	0.0000	2.1872	2.1872	0.08865
0.25	59.323	0.016032	1235.5	1235.5	27.382	1060.1	1087.4	0.0542	2.0425	2.0967	0.25
0.50	79.586	0.016071	641.5	641.5	47.623	1048.6	1096.3	0.0925	1.9446	2.0370	0.50
1.0	101.74	0.016136	333.59	333.60	69.73	1036.1	1105.8	0.1326	1.8455	1.9781	1.0
2.0	126.24	0.016407	173.515	173.532	130.20	1000.9	1131.1	0.2349	1.6094	1.8443	2.0
10.0	193.21	0.016592	38.404	38.420	161.26	982.1	1143.3	0.2836	1.5043	1.7879	10.0
14.696	212.00	0.016719	26.782	26.799	180.17	970.3	1150.5	0.3121	1.4447	1.7568	14.696
15.0	213.03	0.016726	26.274	26.290	181.21	969.7	1150.9	0.3137	1.4415	1.7552	15.0
20.0	227.96	0.016834	20.070	20.087	196.27	960.1	1156.3	0.3358	1.3962	1.7320	20.0
30.0	250.34	0.017009	13.7266	13.7436	218.9	945.2	1164.1	0.3682	1.3313	1.6995	30.0
40.0	267.25	0.017151	10.4794	10.4965	236.1	933.6	1169.8	0.3921	1.2844	1.6765	40.0
50.0	281.02	0.017274	8.4967	8.5140	250.2	923.9	1174.1	0.4112	1.2474	1.6586	50.0
60.0	292.71	0.017383	7.1562	7.1736	262.2	915.4	1177.6	0.4273	1.2167	1.6440	60.0
70.0	302.93	0.017482	6.1875	6.2050	272.7	907.8	1180.6	0.4411	1.1905	1.6316	70.0
80.0	312.04	0.017573	5.4536	5.4711	282.1	900.9	1183.1	0.4534	1.1675	1.6208	80.0
90.0	320.28	0.017659	4.8779	4.8953	290.7	894.6	1185.3	0.4643	1.1470	1.6113	90.0
100.0	327.82	0.017740	4.4133	4.4310	298.5	888.6	1187.2	0.4743	1.1284	1.6027	100.0
110.0	334.79	0.01782	4.0306	4.0484	305.8	883.1	1188.9	0.4834	1.1115	1.5950	110.0
120.0	341.27	0.01789	3.7097	3.7275	312.6	877.8	1190.4	0.4919	1.0960	1.5879	120.0
130.0	347.33	0.01796	3.4364	3.4544	319.0	872.8	1191.7	0.4998	1.0815	1.5813	130.0
140.0	353.04	0.01803	3.2010	3.2190	325.0	868.0	1193.0	0.5071	1.0681	1.5752	140.0
150.0	358.43	0.01809	2.9958	3.0139	330.6	863.4	1194.1	0.5141	1.0554	1.5695	150.0
160.0	363.55	0.01815	2.8155	2.8336	336.1	859.0	1195.1	0.5206	1.0435	1.5641	160.0
170.0	368.42	0.01821	2.6556	2.6738	341.2	854.8	1196.0	0.5269	1.0322	1.5591	170.0
180.0	373.08	0.01827	2.5129	2.5312	346.2	850.7	1196.9	0.5328	1.0215	1.5543	180.0
190.0	377.53	0.01833	2.3847	2.4030	350.9	846.7	1197.6	0.5384	1.0113	1.5498	190.0
200.0	381.80	0.01839	2.2689	2.2873	355.5	842.8	1198.3	0.5438	1.0016	1.5454	200.0
210.0	385.91	0.01844	2.16373	2.18217	359.9	839.1	1199.0	0.5490	0.9923	1.5413	210.0
220.0	389.88	0.01850	2.06779	2.08629	364.2	835.4	1199.6	0.5540	0.9834	1.5374	220.0
230.0	393.70	0.01855	1.97991	1.99846	368.3	831.8	1200.1	0.5588	0.9748	1.5336	230.0
240.0	397.39	0.01860	1.89909	1.91769	372.3	828.4	1200.6	0.5634	0.9665	1.5299	240.0
250.0	400.97	0.01865	1.82452	1.84317	376.1	825.0	1201.1	0.5679	0.9585	1.5264	250.0
260.0	404.44	0.01870	1.75548	1.77418	379.9	821.6	1201.5	0.5722	0.9508	1.5230	260.0
270.0	407.80	0.01875	1.69137	1.71013	383.6	818.3	1201.9	0.5764	0.9433	1.5197	270.0
280.0	411.07	0.01880	1.63169	1.65049	387.1	815.1	1202.3	0.5805	0.9361	1.5166	280.0
290.0	414.25	0.01885	1.57597	1.59482	390.6	812.0	1202.6	0.5844	0.9291	1.5135	290.0
300.0	417.35	0.01889	1.52384	1.54274	394.0	808.9	1202.9	0.5882	0.9223	1.5105	300.0
350.0	431.73	0.01912	1.30642	1.32554	409.8	794.2	1204.0	0.6059	0.8909	1.4968	350.0
400.0	444.60	0.01934	1.14162	1.16095	424.2	780.4	1204.6	0.6217	0.8630	1.4847	400.0
450.0	456.28	0.01954	1.01224	1.03179	437.3	767.5	1204.8	0.6360	0.8378	1.4738	450.0
500.0	467.01	0.01975	0.90787	0.92762	449.5	755.1	1204.7	0.6490	0.8148	1.4639	500.0
550.0	476.94	0.01994	0.82183	0.84177	460.9	743.3	1204.3	0.6611	0.7936	1.4547	550.0
600.0	486.20	0.02013	0.74962	0.76975	471.7	732.0	1203.7	0.6723	0.7738	1.4461	600.0
650.0	494.89	0.02032	0.68811	0.70843	481.9	720.9	1202.8	0.6828	0.7552	1.4381	650.0
700.0	503.08	0.02050	0.63505	0.65556	491.6	710.2	1201.8	0.6928	0.7377	1.4304	700.0
750.0	510.84	0.02069	0.58880	0.60949	500.9	699.8	1200.7	0.7022	0.7210	1.4232	750.0
800.0	518.21	0.02087	0.54805	0.56896	509.8	689.6	1199.4	0.7111	0.7051	1.4163	800.0
850.0	525.24	0.02105	0.51197	0.53302	518.4	679.5	1198.0	0.7197	0.6899	1.4096	850.0
900.0	531.95	0.02123	0.47968	0.50091	526.7	669.7	1196.4	0.7279	0.6753	1.4032	900.0
950.0	538.39	0.02141	0.45064	0.47205	534.7	660.0	1194.7	0.7358	0.6612	1.3970	950.0
1000.0	544.58	0.02159	0.42436	0.44596	542.6	650.4	1192.9	0.7434	0.6476	1.3910	1000.0
1050.0	550.53	0.02177	0.40047	0.42224	550.1	640.9	1191.0	0.7507	0.6344	1.3851	1050.0
1100.0	556.28	0.02195	0.37863	0.40058	557.5	631.5	1189.1	0.7578	0.6216	1.3794	1100.0
1150.0	561.82	0.02214	0.35859	0.38073	564.8	622.2	1187.0	0.7647	0.6091	1.3738	1150.0
1200.0	567.19	0.02232	0.34013	0.36245	571.9	613.0	1184.8	0.7714	0.5969	1.3683	1200.0
1250.0	572.38	0.02250	0.32306	0.34556	578.8	603.8	1182.6	0.7780	0.5850	1.3630	1250.0
1300.0	577.42	0.02269	0.30722	0.32991	585.6	594.6	1180.2	0.7843	0.5733	1.3577	1300.0
1350.0	582.32	0.02288	0.29250	0.31537	592.3	585.4	1177.8	0.7906	0.5620	1.3525	1350.0
1400.0	587.07	0.02307	0.27871	0.30178	598.8	576.5	1175.3	0.7966	0.5507	1.3474	1400.0
1450.0	591.70	0.02327	0.26584	0.28911	605.3	567.4	1172.8	0.8026	0.5397	1.3423	1450.0
1500.0	596.20	0.02346	0.25372	0.27719	611.7	558.4	1170.1	0.8085	0.5288	1.3373	1500.0
1550.0	600.59	0.02366	0.24235	0.26601	618.0	549.4	1167.4	0.8142	0.5182	1.3324	1550.0
1600.0	604.87	0.02387	0.23159	0.25545	624.2	540.3	1164.5	0.8199	0.5076	1.3274	1600.0
1650.0	609.05	0.02407	0.22143	0.24551	630.4	531.3	1161.6	0.8254	0.4971	1.3225	1650.0
1700.0	613.13	0.02428	0.21178	0.23607	636.5	522.2	1158.6	0.8309	0.4867	1.3176	1700.0
1750.0	617.12	0.02450	0.20263	0.22713	642.5	513.1	1155.6	0.8363	0.4765	1.3128	1750.0
1800.0	621.02	0.02472	0.19390	0.21861	648.5	503.8	1152.3	0.8417	0.4662	1.3079	1800.0
1850.0	624.83	0.02495	0.18558	0.21052	654.5	494.6	1149.0	0.8470	0.4561	1.3030	1850.0
1900.0	628.56	0.02517	0.17761	0.20278	660.4	485.2	1145.6	0.8522	0.4459	1.2981	1900.0
1950.0	632.22	0.02541	0.16999	0.19540	666.3	475.8	1142.0	0.8574	0.4358	1.2931	1950.0
2000.0	635.80	0.02565	0.16266	0.18831	672.1	466.2	1138.3	0.8625	0.4256	1.2881	2000.0
2100.0	642.76	0.02615	0.14885	0.17501	683.8	446.7	1130.5	0.8727	0.4053	1.2780	2100.0
2200.0	649.45	0.02669	0.13603	0.16272	695.5	426.7	1122.2	0.8828	0.3848	1.2676	2200.0
2300.0	655.89	0.02727	0.12406	0.15133	707.2	406.0	1113.2	0.8929	0.3640	1.2569	2300.0
2400.0	662.11	0.02790	0.11287	0.14076	719.0	384.8	1103.7	0.9031	0.3430	1.2460	2400.0
2500.0	668.11	0.02859	0.10209	0.13068	731.7	361.6	1093.3	0.9139	0.3206	1.2345	2500.0
2600.0	673.91	0.02938	0.09172	0.12110	744.5	337.6	1082.0	0.9247	0.2977	1.2225	2600.0
2700.0	679.53	0.03029	0.08165	0.11194	757.3	312.3	1069.7	0.9356	0.2741	1.2097	2700.0
2800.0	684.96	0.03134	0.07171	0.10305	770.7	285.1	1055.8	0.9468	0.2491	1.1958	2800.0
2900.0	690.22	0.03262	0.06158	0.09420	785.1	254.7	1039.8	0.9588	0.2215	1.1803	2900.0
3000.0	695.33	0.03428	0.05073	0.08500	801.8	218.4	1020.3	0.9728	0.1891	1.1619	3000.0
3100.0	700.28	0.03681	0.03771	0.07452	824.0	169.3	993.3	0.9914	0.1460	1.1373	3100.0
3200.0	705.08	0.04472	0.01191	0.05663	875.5	56.1	931.6	1.0351	0.0482	1.0832	3200.0
3206.2*	705.47	0.05078	0.00000	0.05078	906.0	0.0	906.0	1.0612	0.0000	1.0612	3206.2*

*Critical pressure

ANSWERS -- COOK 1&2 -85/02/26-HIGGINS R.

ANSWER 1.01 (1.00)

(b)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-4.25

ANSWER 1.02 (1.00)

(b)

(b)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-3.15

ANSWER 1.03 (1.00)

(a)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-3.2

ANSWER 1.04 (1.00)

(c)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-5.10

ANSWER 1.05 (1.00)

(c)

ANSWERS -- COOK 1&2 -85/02/26-HIGGINS R.

REFERENCE
Westinghouse Reactor Theory Review Text, p I-5.16 through 5.22

ANSWER 1.06 (1.00)

(b)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-5.40 through 5.42

ANSWER 1.07 (1.00)

(d)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-5.13, 5.50
Tech Specs B 3/4 1-3

ANSWER 1.08 (1.00)

(a)

REFERENCE
PWR Core Physics Text FND-119, B-9, p 21

ANSWER 1.09 (1.00)

(c)

REFERENCE
Westinghouse Reactor Theory Review Text, p I-5.77

ANSWER 1.10 (1.00)

(d)

REFERENCE
PWR Core Physics Text FND-119, B-4, p 51

ANSWERS -- COOK 1&2 -85/02/26-HIGGINS R.

ANSWER 1.11 (1.00)

(c)

REFERENCE
Tech Data Book, Figure 8.8
Westinghouse Reactor Theory Review Text, p I-1.38
1-OHP 4021.001.011 step 6.6

ANSWER 1.12 (1.00)

(a) or (c)

REFERENCE
PWR Core Physics Test FND-119, B-7

ANSWER 1.13 (1.00)

(a)

REFERENCE
Tech Spec 4.1.1.1.1.b

ANSWER 1.14 (1.00)

(c)

REFERENCE
Tech Spec 3.2.4

ANSWER 1.15 (1.00)

(d)

REFERENCE
Tech Spec 3.2.1

ANSWER 1.16 (1.00)

(c)

ANSWERS -- COOK 1&2 -85/02/26-HIGGINS R.

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 9-22

ANSWER 1.17 (1.00)

(d)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 10-43

ANSWER 1.18 (1.00)

(a)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 10-44

ANSWER 1.19 (1.00)

(b)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 10-52

ANSWER 1.20 (1.00)

(d)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 12-53

ANSWER 1.21 (1.00)

(c)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 13-23

ANSWERS -- COOK 1&2 -85/02/26-HIGGINS R.

ANSWER 1.22 (1.00)

(d)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 13-18

ANSWER 1.23 (1.00)

(a)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 13-61

ANSWER 1.24 (1.00)

(c)

REFERENCE
Thermal-Hydraulic Principles and Applications to the PWR II, p 14-27
Natural Circulation Procedure OHP 4023.001.008, steps 2.4, 5.3.1

ANSWER 1.25 (1.00)

(d)

REFERENCE
Steam Tables

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 2.01 (2.00)

A.Hydrogen (high Temp),Hydrazine (Low Temp) [.5 ea][1.0]
REF NS-6-12,13

B.LiOH (LITHIUM) [0.5]
REF.NS-6-13

C.1.Remove ionic corrosion products and certain fission products
2.Act as a mechanical filter for particulates [.25ea][0.5]
REF NS-6-14

ANSWER 2.02 (2.00)

A.Part of the flow from the RCS passes through the RHR Heat Exchangers and part through a bypass line. Both flows are mixed and returned to the RCS (a small portion is diverted to the CVCS for cleanup). The mixed fluids temperature is controlled by varying the flow split. Heat is transferred from the RCS to the Component Cooling System via the RHR Heat Exchangers. RCS flows through the tube side of the Heat Exchangers. [1.0]

REF.NS-8-6

REF.NS-12-55,56

ANSWER 2.03 (3.00)

A.Allows for additional injection water flow through the pump bearing for cooling purposes [0.5]. It is normally used during periods when RCS pressure is low [0.5]. [1.0]

B.Maintains a backpressure on the No.2 seal to force water up into No.3 seal to keep it wet [0.5].From No.3 seal it flows to the RCDT [0.5] [1.0]

C.Diverted to the PRT when the return is isolated via a relief valve when the lift setpoint is reached . [1.0]
REF NS-1,p.43-51

ANSWER 2.04 (1.00)

Feed Reg Valves trip shut [.25],Feed Isolations shut [.25],Feed Pump trips [.25],Main Feed Pump Discharge valves shut [.25] [1.0]

REF.PGS-10

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 2.05 (1.00)

Ensures that a minimum flow through the pump is maintained to prevent pump overheating and possible damage [0.5]. An air operated emergency leakoff valve will open automatically if there is low flow through its associated pump,and will close automatically when the flow rate is above the minimum required. [0.5] [1.0]

REF.AS-11-6

ANSWER 2.06 (2.00)

1.Centrifugal Charging Pump-2540 PSIG ACCEPT 2235
SI Pumps-1725 PSIG ACCEPT (1510-1640)
Accumulators-620 PSIG
RHR-200 PSIG [0.25 ea]

2.Both Charging Pumps start;valves realign to take suction from RWST through the BIT to RCS cold legs;Normal charging,letdown and miniflow are isolated.[IMO-910,911(RWST Suct),IMO-255,256(BIT inlet),ICM-250,251(BIT outlet) all open;QMO-451,452(VCT Outlet) close;QMO-200,201(norm charging) close;QMO-225,226(MINIFLOW)Close;IRV-255,251,252 (BIT recirc)close;QRV-160,161,162(letdown orifice isolation)close;QRV -111,112 (letdown isol) close;QCR-300(cont isol) close;QCM-250,350 (seal return)close]. [1.0]

REF.NS-12-15,29,30[NOTE: info in brackets not necessary for full credit]

ANSWER 2.07 (1.00)

Leakage Detection System-4 pipes which are located to collect leakage to a drain channel located near the Nuclear Sampling Room in the AB.The ends of the drain pipes are located just below the drain channel grating such that leakage may be detected by visual observation. ~~The leakage is then collected by the floor drains system for processing~~ RRF [1.0]

REF.AS-5-13

ANSWER 2.08 (.75)

1.Electronic overspeed-110% of rated speed [0.25]
2.Generator phase differential phase 1 to phase 3 [0.25]
3.Manual pushbutton in CR or DG subpanel [0.25]

REF.AS-10,p.60

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 2.09 (2.25)

A. Permits bridge motion with the gripper tube not at the top limit; bypasses the reverse travel limit switch [0.75]
B. Permits motion toward the fuel transfer canal with the trolley out of the interlock zone and permits motion in any direction when the gripper tube is not at top limit. [0.75]
C. Permits trolley motion in either direction with the gripper tube not at top limit. Also permits trolley motion when the bridge is beyond the core area and in the transfer canal area. [0.75]

REF. NS-16-34

ANSWER 2.10 (.75)

A. Recirculate HUT to ensure mixing [0.25]
B. Transfer contents of 1 HUT to another [0.25]
C. Transfer water from the HUT's to the SF Transfer canal when necessary [0.25]

REF. NS-7-15

ANSWER 2.11 (1.00)

A. 120 GPM [0.5]
B. At flows greater than 120 GPM, resin channeling can occur in the letdown demineralizers. [0.5]

REF. NS-6-84

ANSWER 2.12 (1.50)

1. Acts as a barrier to prevent the leakage of hydrogen gas or steam through the safety valve seats [0.75
2. Condensate accumulates in the loop seal due to normal heat transfer from the primary system to the containment atmosphere. [0.75]

REF. NS-3, p. 23

DESIGN IS CHANGED - LOOP SEAL IS CONT. DRAINED TO LOWER PRESSURIZER LEVEL TAP
(MUST MENTION FOR FULL CREDIT -.75 IF NOT)

ANSWERS -- COOK 1&2 -B5/02/26-R.R.FERRELL

ANSWER 2.13 (1.00)

A.TRUE
B.TRUE
C.FALSE
D.FALSE [.25 ea.]

REF.AS-7-5,17,18

ANSWER 2.14 (1.25)

The eductors draw the Sodium Hydroxide from the SAT and mix it with a portion of the discharge flow from the spray pump. Eductors are designed to meter the proper amount of NaOH into the spray solution. [0.5]

A portion of the discharge flow from each pump is directed to its associated eductor. The water flow passing through the eductor nozzle(motive Fluid) creates a low pressure area which then draws the NaOH(suction fluid) from the SAT into the main flow stream. The mix of additive solution and pump discharge water is then returned to the spray pumps suction. The eductors are self priming and require no operator action. [0.75]

REF.NS-15

ANSWER 2.15 (1.50)

A.True[PGS-13A-45]
B.False[PGS-13A-4]
C.False[PGS-13A-14]
D.True[PGS-13A-23] FALSE FOR U-2 (PGS-13B-59
E.True[PGS-13A-59]

[0.3 ea]

ANSWER 2.16 (1.00)

Pressure below 15 psig may result in damage to RCP seals. [0.5]
Pressure above 50 psig increases chances of accidental release. [0.5]
[1.0]

REF.1-OHP 4021.003.005

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 2.17 (1.00)

Two recombiners in top of containment-use electric heating elements to increase the temperature of the containment atmosphere passing through them. The temperature is raised to the point where the hyorogen and oxygen spontaneously recombine to form steam. The containment atmosphere, containing hydrogen, is drawn into the recombiner by natural convection. The steam produced is mixed withthe containment atmosphere in a plenum above the heating elements and then returned to the containment. [1.0]

REF.NS-15-3

ANSWER 2.18 (1.00)

U-1 The pre-engagement motor is used to provide engaging torque when the shaft is stopped. The turning gear motor continues turning the shaft after the turning gear is engaged, and the pre-engagement motor is de-energized. A torque limiting slip clutch is provided to prevent overloading the turning gear motor. The turning gear can be engaged manually or remotely. It must be running to engage the gear with the shaft,since the pinion and bull gear teeth will not engage unless their positions match.The turning gear will automatically disengage when the torque output to the turbine rotor exceeds the turning gear torque. [1.0]
REF.FGS-4A-25

U-2 THE TURNING GEAR MOTOR TURNS THE SHAFT THROUGH A HYDRAULIC COUPLING AND REDUCTION GEAR DRIVE. TO PLACE THE MAIN TURBINE ON THE TURNING GEAR, THE CONTROL SWITCH IS PLACED TO ON. NO MANUAL METHOD OF ENGAGING

REF FGS-4B-23,24

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 3.01 (1.00)

Operation of this relay and its associated contacts determines the operational status of the DG start/run electrical circuitry and allows all necessary auxiliaries to operate as necessary. Two position switch:Trip and reset.Must be placed in reset to latch the HEA (tripping) relay after any of the DG trips are received. After a trip signal-relay is energized and releases itself from reset by spring action. Resetting can only be accomplished after clearing the trip condition. The DG cannot be started with the HEA lockout relay in the tripped condition. [1.0]

REF.AS-10-59

ANSWER 3.02 (1.50)

A.1.Containment pressure as indicated on 2/4 inst at greater than 1.1 psig
2.High steam line flow coincident with either low steam line pressure or low low Tave in unit 1 [unit 2 requires only low steam line pressure (SI), or high steam line flow coincident with low low Tave].
[steam pressure-600 psig,Tave-541 degrees F] [0.75]
B.Containment pressure as indicated on 2/4 instruments at greater than 2.9 psig [0.75]

WILL ACCEPT MANUAL ACTUATION

REF.NS-11-47

ANSWER 3.03 (1.00)

A.Unit 1 or 2 air handlers Glycol temp high
B.Refrigeration compressors (1-10)lockout or failure
C.Unit 1 or 2 air handlers Glycol temp low
D.Refrigeration Compressors (1-10) oil temp high
E.Glycol circulating pumps (1-6) failure
F.Glycol Circulating pumps (1-6) discharge pressure low [4/6 ,.25 ea.]

REF.NS-14-49

WILL ALSO ACCEPT ALL DROPS ON ANN 35

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 3.04 (2.25)

A. Charging goes to maximum[indicated level is greater than actual;-5% low deviation,B/U htrs off, letdown isolates] [0.50]
B. [Charging increases,letdown isolates] actual level increases [0.50]
C. Rx trip [.25] on high pressurizer level-no letdown maximum charging, pressurizer fills up on to high level trip setpoint.[0.5] [0.75]
D. VCT level decreases,M/U starts,VCT isolates on lo-lo level,charging suction switches to RWST,level increases to ~~44~~ 24%,auto M/U shutsoff [0.50]
[2.25]

ALTERNATE TO C: Rx TRIPON LO PRESSURE DUE TO CHARGING SWITCHES SUCTION TO RWST DURATING RCS CAUSING TAVE/PRESS. TO DECREASE

REF.2-OHP 4022.003.002

ANSWER 3.05 (1.25)

A. Letdown flow is too high
Charging flow is too low [.75]
B. Check normal letdown flow
Ensure QRV-301 is maintaining pressure at 340 psig
Increase charging flow
Monitor RCP labrynth seal Delta-P [0.5]

REF.1-OHP 4024.109.028

ANSWER 3.06 (1.00)

OT Delta-T
OP Delta-T
Low Low Tave/High Steam Trip
Low Tave interlock/FW Trip
Rod Control
Press Level Control
Steam Dump Control
High Tave
Reactivity Computer
RIL Comparator
Tave-Tref Deviation
Turbine Runback and block withdrawl
[any 5,.2 ea.]

REF.OP-1-98501-1;2-98501-2

ANSWER 3.07 (1.50)

A. CCW surge tank level increases,rad monitors in CCW pump discharge alarm [1.0][0.5 ea.]
B. Surge Tank Vent Valve (CRV-412) closes [0.5]

REF.AS-1-43

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 3.08 (1.75)

A.1.Provides a high gain at low power and a low gain at high power(to give adequate control at low power and stable control at high power). [0.5]
AUCTIONEERED HIGH
2. ~~Average~~ Nuclear Power FROM NON-LINEAR GAIN UNIT
Turbine Power [0.5]

B.1.0 or 8 SPM
2.8 SPM
3.72 SPM [0.75]

REF.NS-3

ANSWER 3.09 (2.25)

A.Tave goes high,program level increases,charging increases,level increases [0.75]

B.Pressure indications on failed channel read high
Pressurizer pressure high alarm ~~because letdown isolates and charging inc~~ RRF
Pressurizer heaters off
Both sprays open
Pressurizer high pressure deviation alarm
Actual pressure decreasing
Possible Rx trip [0.75]

C.Pressure reads low on the channel
Pressurizer pressure low alarm
B/U heaters on
Proportional heaters on full
Pressure on other channels increase
PORV's lift over a period of time [0.75]

REF.NS-3;1-OHP 4022.002.011,012

ANSWER 3.10 (1.00)

A.Power Range neutron flux high:low-~~less than or = 25%~~ RRF 25% of rated thermal pwr
[2/4] high ~~Rx trip~~ 109% " " " "
B.Power Range neutron flux,high positive rate [2/4]
C. " " " " negative " [2/4]
D.Intermediate Range neutron flux:~~less than or~~ RRF 25% of rated thermal pwr
E.Source Range neutron flux:~~less than or~~ RRF 10e5 CPS [1/2]

REF.NS-9-61 [0.25 ea.,1.0]

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 3.11 (1.00)

A.Step in to decrease 'indicated'power(until ROC of PM=Temp error) [0.25]
B.decreases setpoint to trip channel [0.25]
C.No affect [0.25]
D.Goes to large negative (I top-I bottom) [0.25]

REF.02-OHP 4022.013.004 [1.0]

ANSWER 3.12 (1.75)

A.Source-BF3 Proportional Counter
Intermediate-CIC
Power-UIC [0.25 ea.]
B.Gammas are proportional to power in the power range
Neutron flux levels are many times that of gammas [0.25 ea.]
C.Source range may not turn on automatically
Does not agree with other channel [0.25 ea.]

REF.NS-9

ANSWER 3.13 (1.00)

A.PR NI Overpower Rod Stop
B.IR NI Overpower Rod Stop
C.OP Delta-T at 3% less than trip setpoint Rod Stop
D.OT Delta-T " " " " " " " "
E.Urgent Failure Rod Stop [1.0][.02 ea.]

REF.NS-4

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 3.14 (2.00)

A.1.Condenser vaccum greater than 10.6 inches Hg on 3/3 condenser pressure instruments;Circulating Water pump must be running [.15 ea.]

Ensures condenser available to condense steam [.15]

2.Tavg greater than 541 degrees F in 3/4 loops [.15]

Prevents uncontrolled cooldown [.15]

B.STEAM PRESSURE-setpoint dialed in and compared to actual steam pressure to generate an error signal. Dumps open/close to maintain setpoint [.25]
TAVG MODE:LOAD REJECTION-Tavg is compared to Tref to generate an error signal which opens/closes dumps to bring Tavg=Tref [.25]
TURBINE TRIP-Tavg compared to no load Tavg(fixed setpoint) and dumps open to bring Tavg=Tno-load. [.25]

C.STEAM PRESSURE-during startup to the point of placing in Tavg mode [.25]
TAVG-App.15% power and may be completed after turbine load has increased to the point where the dumps have closed. [.25]

REF.1-OHP 4022.001.006;PGS-12-31,32

ANSWER 3.15 (1.00)

A.Group-Counts the pulses sent to the rods and produces a direct current, analog signal that drives digital indication for each group on the Main Control Board. [0.5]

B.Individual-A.C.output of the position indication coil stack is converted to a direct current,analog signal and drives meter indication for each rod on the Main Control Board. [0.5]

REF.NS-4-9

ANSWER 3.16 (1.75)

A.Steam Flow
Feed Flow
Steam Pressure
Turbine Impulse Pressure
S/G Level [4/5,0.25 each][1.0]

B.S/G Header Pressure
Feed Pump Discharge Pressure
No-Load Setpoint
Total Steam Flow [3/4,0.25 each][0.75]

REF.PGS-10-37,38;PGS-11

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 3.17 (1.00)

Two positions-BLOCKED and UNBLOCK-Manually block and unblock the circuit. Each switch controls the input from one RCS pressure detector to its associated relief valve. [0.50]

BLOCK-control signals for the associated valve will not cause the valve to open at the reduced pressure setpoint. However, normal operation of the valve at its high pressure setpoint (~~2385~~ 2335 psig) is not affected. [0.25]

UNBLOCK-control signals for the associated valve will cause the valve to open if RCS pressure increases above 435 psig. [0.25]

[1.00]

REF.NS-3

ANSWER 3.18 (1.00)

4 Pressurizer pressure channels send signals which are available to control the PORV's when they are in auto. Each relief valve receives 2 signals when in auto. One of these inputs is the overpressure signal which will cause the valve to open when its lift setpoint is reached. The other input is from a different pressure channel and acts to block(close) the valve if pressure decreases to ~~2185~~ 2235 psig. Since the overpressure and blocking come from different channels, the plant is protected from a loss of pressure due to a single sensor failure. [1.0]

REF.NS-3-12

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 4.01 (1.50)

A 1.1.25 REM [0.25]
2.18.75 R [0.25]
3.7.5 REM [0.25]
B.self-reading dosimeter and TLD [0.75]
REF.PMP 6010.RAD.001,pg 36 and 61,rev 6;10CFR20

ANSWER 4.02 (2.00)

A.Verify steam dump controls have functioned to limit Tave and pressurizer press. transients. If not, trip the Rx.
B.Monitor Rx power to ensure the rods are moving inward to reduce power level. If not, take manual control and reduce Rx power.
C.Adjust turbine speed to maintain frequency at 60 HZ.
D.Monitor Tave to ensure the Steam Dumps are performing properly; take manual control if required. [.5 ea,2.0]

ANSWER 4.03 (1.25)

NO A.~~False~~ [1-OHP 4022.057.001]
NO B.~~False~~ [" " 055.001]
NO C.~~False~~ [" " 012.004]
YES D.~~True~~ [" " 060.001]
YES E.~~True~~ [" " 002.001] [.25 ea.]

ANSWER 4.04 (1.00)

A.YES [0.5]
B.NO [0.5]

REF.PMI-2110,para.3.6,rev 8

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 4.05 (1.75)

1.Review CR log
2.Review non-conforming equipment log
3.Review log for jumpers, lifted wires, blocked relays, blocked alarms
4.Review surveillance schedule
5.Control Panel walkdown
6.Review standing orders, operating memos or instructions
7.Discuss conditions with off-going operator [0.25 ea]

REF.OHI-4012,section 3.4.2

ANSWER 4.06 (2.00)

1.Boron Concentration
2.Control Rod Position
3.Power Defect(MTC and Doppler)
4.Xe
5.Sm
6.Pu [4/6,0.5 ea]

REF.1-OHP 4021.001.011,par 8.3,.4,.5,.6,rev 6

ANSWER 4.07 (2.50) CAF for numbers

A.Air Ejector Monitor
Gland Steam Packing Exhaust Monitor
SG Blowdown Monitor [0.25 ea.]
B.Verify BIT flow to the RCS [.25] verify AFW flow to SG's [.25] verify heat being removed from the RCS via SG's and steam dumping to the condenser [.25] RCS temp.decreasing to no-load [.25] [1.0]
C.Isolate stm supply from both (#2,#3) SG's immediately [0.75]

REF.1-OHP 4023.001.004,p.2,3,4

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 4.08 (1.75)

A.Backflow of hot reactor coolant through the radial bearing and the seal package will result in damage (or subsequent thermal shock) [0.5]
B.RCS cold leg RTD [.25],RCS hot leg RTD [.25],Incore Thermocouples[.25] [0.75]
C.RCS void formation [0.5]

REF.1-OHP 4023.001.008,p.1-3
• 4021.002.003,p.5

ANSWER 4.09 (1.00)

Less than 350 degrees F [.5] and 425 psig [.5] [1.0]

REF.1-OHP 4021.017.002,p.2

ANSWER 4.10 (2.00)

A.Once each shift
When an unanticipated change in reactivity occurs
Tech Spec Limit of once/24 hours
(2/3 for full credit) [0.5 ea.]
B.Immediately initiate emergency boration[.25] at greater than 10 GPM[.25] of 20,000 PPM Boric Acid [.25] until the required SDM is restored [.25] [1.0]

REF.1-OHP 4021.001.001;Tech Specs

ANSWER 4.11 (1.00)

SR-2/2
IR-2/2
PR-3/4 [.33 ea.][1.0]

REF.Tech Specs,table 3.3-1,p.3/4 3-2

ANSWER 4.12 (.75)

Stop all RCP's when RCS pressure drops below 1450 psig [.75]

REF.1-OHP 4023.001.009

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 4.13 (1.50)

A. Pressurizer Relief Disch. Temp. High Alarm
Tank Temp High
Press.
Level

Decreasing pressurizer level
Loss of RCS Inventory
Increasing Makeup time [any 3, .25 ea]

B. Close all 3 MOV's (2NM0-152, 153, ~~154~~ 151) [.75]

REF. 2-OHP 4022.002.009

ANSWER 4.14 (1.00)

a. Excessive control rod insertion

b. Failure of a control or shutdown rod to drop during a reactor trip

c. Uncontrolled cooldown following a reactor trip

d. Unexpected or unexplained reactivity increase

e. Shutdown margin less than 1.75% DK/K [4 @ .25 ea]

REFERENCE: 4022.005.002

ANSWER 4.15 (2.00)

A. TRUE
B. FALSE
C. TRUE
D. TRUE
E. TRUE [.4 ea.][1.0]

REF. 1-OHP 4021.001.002

ANSWERS -- COOK 1&2 -85/02/26-R.R.FERRELL

ANSWER 4.16 (2.00)

A. Minimize the buildup of Boric Acid in the upper portion of the core. [Evaporation boiling can cause an insulating film of BA crystals to form, allowing the cladding to heat up. In addition to risking fuel destruction and hydrogen buildup, this would be a violation of the ECCS criteria on post-accident core cooling.] [1.0]

B. During ECCS recirculation, if the containment spray pumps seem inadequate to reduce containment pressure below 8 psig, the flow from one RHR Hx may be partially or fully diverted to the spray pumps. [1.0]

REF. NS-12-55,56

MASTER

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

FACILITY: COOK 1&2

REACTOR TYPE: PWR-WEC4

DATE ADMINISTERED: 85/02/26

EXAMINER: T BURDICK

APPLICANT: _____

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			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	100.00			TOTALS

FINAL GRADE _____%

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

_____
APPLICANT'S SIGNATURE

REVIEWERS: MIGRAU/HUNT
DAVIDSON/NICHOLS
TOLLAS/HYNES
STRASSER/DRAKER

QUESTION 5.01 (2.00)

Compare the estimated critical position (ECP) for a startup 15 hours after a trip to the actual critical rod position (ACP) for the following events or conditions. Consider each independently. Indicate whether the ACP will be higher than, lower than or the same as the ECP.

a. All steam generator levels are raised by 10% 5 minutres prior to startup.

b. One reactor coolant pump is stopped one minute prior to criticality.

c. The steam dump pressure setpoint is increased to a value just below the lowest code safety setpoint.

d. The startup is delayed two more hours.

e. Condenser vacuum is decreased by 2 inches of mercury.

QUESTION 5.02 (1.00)

In the D.C. Cook reactors the moderator temperature coefficient (MTC) varies with certain plant conditions. The MTC: (choose the correct answer)

a. becomes more negative as boron is removed.

b. varies inversely with temperature changes.

c. becomes less negative as boron is removed .

d. varies inversely with core life.

QUESTION 5.03 (1.00)

Which of the following would have the least affect on a failure due to pressurized thermal shock? (choose the correct answer)

a. temperature
b. pressure (stress)
c. residual stress
d. gamma radiation history
e. size of existing flaw
f. temperature gradient

QUESTION 5.04 (1.00)

Which of the following statements is true concerning natural circulation? (choose the correct answer)

a. If natural circulation is lost or decreases hot-to-cold leg differential temperature will decrease.

b. Steam generator pressure will decrease if circulation is lost.

c. If circulation is lost then hot and cold leg temperatures will increase slightly.

d. Steam generator level will initially decrease on a loss of natural circulation.

QUESTION 5.05 (2.00)

In the procedure for natural circulation cooldown of the reactor coolant system there are specific RCS and steam generator pressures at which extended soak periods are required.

a. Why does the procedure specify points of RCS pressure coincident with a specific steam generator pressure?

b. Why does the procedure specify extended soak times during the cooldown?

QUESTION 5.06 (2.00)

The following statements concern fission product poisons. Complete the statements with the available answers given. Place the answers on your answer sheet. (Answer can be used more than once)

a. It takes about ____ hours to reach the maximum Xenon concentration after a reactor trip

b. The decay half-life of Xenon 135 is approximately ____ hours.

c. It takes about ____ hours to reach equilibrium Xenon concentration after a step increase from 0 to 50% power.

d. The decay half-life of Promethium 149 to Samarium 149 is approximately ____ hours.

Possible Answers:

0 hours; 5 hours; 10 hours; 20 hours; 50 hours; 80 hours

QUESTION 5.07 (1.50)

Explain why you agree or disagree with the following statement:

"Core thermal neutron flux is highest in the fuel pellets"

QUESTION 5.08 (1.50)

Why can the steam generators deliver the same amount of energy as the reactor but with only a fraction of the reactor core mass flow rate?

QUESTION 5.09 (2.00)

The following are statements related to the operation of pumps. Indicate whether the statements are TRUE or FALSE.

a. If a centrifugal pump speed is doubled the discharge pressure and flow will be doubled.

b. A positive displacement pump will deliver a higher mass flowrate if the temperature of the liquid at the pump suction is lowered.

c. Positive displacement pumps do not require a minimum suction head for proper operation.

d. Centrifugal pumps do require a minimum suction head for proper operation.

QUESTION 5.10 (1.00)

Unit one is subcritical with an initial count rate of 20 cps. Boron is diluted resulting in a stable countrate of 30 cps. Which of the following is closest to the value for K-effective at the new count rate? The core was 10% shutdown prior to the dilution.

a. .99
b. .94
c. .90
d. .80

QUESTION 5.11 (1.00)

Which of the following statements concerning delayed neutrons is correct?

a. Delayed neutrons affect the neutron multiplication cycle to the same degree as prompt neutrons.

b. Delayed neutrons are more likely to leak from the core since they tend to be born near the core periphery.

c. The importance factor (I) relates the effective mean life of the delayed neutron precurssors to the effective delayed neutrton fraction.

d. The importance factor is less than one in Westinghouse reactors because of the large amount of fast fission.

QUESTION 5.12 (1.00)

Increasing the boron concentration at low temperature has little affect on the moderator temperature coefficient as compared to higher operating temperatures because: (choose the correct answer)

a. water density does not change much at low temperature.

b. water density is greater at lower temperatures so neutron leakage is less.

c. water density is greater at lower temperatures so parasitic neutrton absorption is greater.

d. boric acid is less soluable at lower temperatures.

QUESTION 5.13 (1.00)

As boron concentration increases the moderator temperature coefficient becomes less negative because of the: (choose the correct answer)

a. increased neutron leakage.

b. decreased neutron leakage.

c. increased absorption of neutrons in the moderator.

d. decreased absorption of neutrtons in the moderator.

QUESTION 5.14 (1.00)

Differential boron worth: (choose the correct answer)

a. is unaffected by changes in boron concentration.

b. becomes greater as moderator temperature increases.

c. decreases in a linear relationship with core age.

d. decreases as fission products build up in the core.

QUESTION 5.15 (1.00)

Equilibrium Samarium reactivity is: (choose the correct answer)

a. directly proportional to reactor power.

b. inversely proportional to reactor power.

c. not a function of reactor power.

d. offset by burnable poison rods.

QUESTION 5.16 (1.00)

The shutdown margin calculation includes all of the following parameters except: (choose the correct answer)

a. boron concentration.

b. reactor coolant temperature.

c. fuel burnup.

d. samarium concentration.

QUESTION 5.17 (1.00)

The adequacy of the shutdown margin is satisfied in mode one when: (choose the correct answer)

a. the control banks are above the insertion limit.

b. the RCS boron concentration equals or exceeds the normalized value.

c. the moderator temperature coefficient is less than -3.5 e-4 DK/K/deg. F.

d. the RCS temperature exceeds 551 degrees F.

QUESTION 5.18 (1.00)

The quadrant power tilt ratio shall not exceed: (choose the correct answer)

a. 1.002
b. 1.000
c. 1.020
d. 1.200

QUESTION 5.19 (1.00)

Assuming all other factors are the same the mass flow rate through a 3 inch line will be about ____ times that of a 2 inch line.

a. 1.5
b. 2.25
c. 3
d. 4.5

QUESTION 5.20 (1.00)

If all other factors are the same and the pressure drop through a line doubles then the flow rate through that line will increase by a factor of about____:

a. 3.24
b. 4.11
c. 2.44
d. 1.41

QUESTION 6.01 (1.00)

What condition automatically initiates the defrost cycle in the ice condenser air handling units?

QUESTION 6.02 (1.25)

The reactor operator on unit one is performing operability stroke tests on the BIT isolation valves. As he begins to close the last valve an inadvertent SI occurs. Describe the subsequent operation of the valve following the SI. Assume the valve is in automatic.

QUESTION 6.03 (2.00)

Can the diesel generator be started without service water available? Explain your answer.

QUESTION 6.04 (3.00)

State the changes that take place automatically in the component cooling water system during:

a. safety injection actuation
b. phase A containment isolation
c. phase B containment isolation

QUESTION 6.05 (1.25)

The two turbine generator units have hydraulic control and protection systems. Name those ~~protection features~~ TRIPS that are unique to either unit one or two.

QUESTION 6.06 (1.50)

a. What is the function of the combined stop/intercept valves? [1.0]

b. What percentage of total steam flow passes through these valves at full power? [0.5]

QUESTION 6.07 (1.00)

Steam Generator blowdown isolation valves close on 5 automatic signals. Name those signals.

QUESTION 6.08 (3.00)

A. What is the purpose of the No.1 seal bypass valve on the RCP and when is it generally used? [1.0]

B. What is the purpose of the No.2 seal standpipe and where does the water go from the standpipe? [1.0]

C. The RCP No.1 seal water return flow to the CVCS is isolated upon an SI actuation. What provision is made for maintaining seal leakoff after the isolation valves close? [1.0]

QUESTION 6.09 (1.00)

List four (4) automatic actions that occur in the Main Feedwater System upon receipt of an ESF actuation signal. [1.0]

QUESTION 6.10 (1.50)

List three (3) conditions that can trip the Diesel Generator when it is supplying power to the emergency bus following a blackout or SI. [1.5]

QUESTION 6.11 (2.25)

Explain the function of the following manipulator crane interlock bypass switches:

1. Bridge Reverse Interlock Bypass Switch [0.75]
2. Bridge Forward Interlock Bypass Switch [0.75]
3. Trolley Bypass Interlock Switch [0.75]

QUESTION 6.12 (.75)

List three (3) functions of the Hold-up Tank Recirculation Pump. [0.75]

QUESTION 6.13 (1.25)

Briefly describe the operation of the electric hydrogen recombiners located in containment during a LOCA.

QUESTION 6.14 (1.50)

What automatically initiates the following protective actions (include both setpoints and coincidence)?

a. Steam Line Isolation [0.75]
b. Containment Spray [0.75]

QUESTION 6.15 (1.00)

List 4 conditions that will actuate the 'Ice Condenser Refrigeration System Abnormal'annunciator. [1.0]

QUESTION 6.16 (1.75)

a. The Automatic Rod Control System utilizes a variable gain unit. Answer the following:
   1.What is the purpose of the unit? [0.5]
   2.What are the inputs to the unit? [0.5]

b. Give the rod speeds for the following temperature deviations:
   1.1.5 degrees F
   2.2.0 " "
   3.6.0 " " [0.75]

QUESTION 7.01 (1.00)

The procedure "Malfunction of a reactor coolant pump" states that mode 3 requires 2 RCP's running if the rod control system is capable of withdrawing any RCCA. Why?

QUESTION 7.02 (3.00)

a. How soon must the seal leakoff isolation valve be closed following number one seal damage? [0.5]

b. How long can a reactor coolant pump operate on number two seal following number one seal failure? [0.5]

c. What precautions are followed to restore lost seal injection flow to a reactor coolant pump? [1.0]

d. Name four types of reactor coolant pump failures requiring an immediate manual reactor trip per procedure. Be specific. [1.0]

QUESTION 7.03 (2.00)

Per 02-OHP 4022.005.002, "Emergency Boration", list 4 conditions where the RO must commence Emergency Boration.

QUESTION 7.04 (2.00)

a. What are the procedural guidelines for the earliest and latest point at which ECC recirculation should be initiated following an accident? [1.0]

b. When, following the accident, is hot leg recirculation initiated and why? [1.0]

QUESTION 7.05 (2.50)

State the five immediate manual actions required for a loss of reactor coolant per the procedure.

QUESTION 7.06 (1.00)

A maximum of ____ charging pump(s) and ____ safety injection pump(s) shall be operable whenever the temperature of one or more of the RCS cold legs is less than or equal to ~~205~~ 188 degrees F. (choose the correct answer)

a. 1, 1
b. 0, 1
c. 2, 1
d. 1, 0

QUESTION 7.07 (1.00)

State the two cases in which a pocket dosimeter should be rezeroed in accordance with radiation protection procedure.

QUESTION 7.08 (1.00)

Per the 'plant heatup fron cold shutdown to hot standby' procedure, the RHR loop must be isolated from the RCS before the reactor coolant temperature reaches___or the pressure reaches___. (choose the correct answer)

a. 350 F, 600 psig
b. 350 F, 425 psig
c. 425 F, 600 psig
d. 425 F, 350 psig

QUESTION 7.09 (1.00)

The mixed bed demineralizers are removed from service prior to the addition of hydrazine because hydrazine will: (choose the correct answer)

a. cause chloride ejection from the mixed beds.
b. cause the resin beads in the mixed beds to solidify.
c. prevent the absorption of cesium in the mixed beds.
d. break down into hydrogen and oxygen.

QUESTION 7.10 (1.00)

State both the 10 CFR 20 limit and the local administrative dose limit for whole body radiation exposure.

QUESTION 7.11 (1.00)

When an MSR is removed from service the: (choose the corrrect answer)

a. opposite MSR must be removed from service to prevent moisture carryover in the affected LP turbine.

b. opposite MSR must be removed from service to avoid overpressurizing the low pressure hood.

c. opposite MSR must be removed from service to prevent a difference in steam temperature from occuring across the low pressure hood.

d. turbine power must be reduced to prevent moisture carryover into the affected LP turbine.

QUESTION 7.12 (1.00)

In accordance with the "plant cooldown from hot standby to cold shutdown" procedure, cooldown may commence concurrent with boration provided that the: (choose the correct answer)

a. reactor trip breakers are open.

b. boron addition rate is greater than 10 gpm.

c. shutdown banks are fully inserted.

d. RCS cooldown rate does not exceed 100 degrees per hour.

QUESTION 7.13 (1.00)

In accordance with the "plant cooldown from hot standby to cold shutdown" procedure, if two PORV's become inoperable when one or more of the RCS cold legs is less than or equal to 188 degrees then: (choose the correct answer)

a. establish an RCS vent of greater than or equal to two square inches.

b. heatup the RCS to greater than 188 degrees.

c. drain the pressurizer to less than 62%.

d. stop the running RHR pumps.

QUESTION 7.14 (1.00)

In accordance with the "plant cooldown from hot standby to cold shutdown" procedure, if an overpressure condition occurs in the RCS during solid plant with no air bubble in the steam generators and no steam bubble in the pressurizer then verify 1-NRV-152 and 153 automatically open or open them and: (choose the correct answer)

a. isolate the charging header and trip the running charging pump.

b. deenergize the pressurizer heaters and trip the running charging pump.

c trip one RHR pump and trip the running charging pump.

d. increase letdown flow and trip the running charging pump.

QUESTION 7.15 (1.00)

In accordance with the "plant cooldown from hot standby to cold shutdown" procedure: (choose the correct answer)

a. do not remove control rod drive ventilation from service until the RCS temperature is below 150 degrees.

b. when cooling down with the shutdown rods withdrawn ensure the control rods are fully inserted.

c. single RCP operation above 541 degrees is permitted only if the reactor trip breakers are open and the MG sets are shutdown.

d. RHR pumps must not be operated when RCS pressure is below 325 psig.

QUESTION 7.16 (1.00)

In accordance with the reactor coolant pump operating procedure: (choose the correct answer)

a. a reactor coolant pump is not to be operated without seal injection except in emergencies.

b. 325 psig in the RCS will assure a minimum of 275 psig across the number one seal.

c. the number one seal bypass valve will be open whenever number one seal leakoff is less than one gpm.

d. with proper approval a RCP may be started with less than 0.3 gpm leak-off from number one seal.

QUESTION 7.17 (2.00)

What are the four SI termination criteria for a large steam break where reactor vessel integrity is of concern?

QUESTION 7.18 (1.50)

Before the the reactor vessel head post-accident vent system can be used to eliminate noncondensible gases from the RCS, from where must permission be obtained? Three answers are required.

QUESTION 8.01 (2.00)

Unit two is recovering from an outage and is in mode three at the zero ~~power~~ % Power & no load temperature. One of the four operating reactor coolant pumps must be stopped. What are the two alternative actions required to satisfy technical specifications for this condition? Assume the condition exists for greater than one hour.

QUESTION 8.02 (3.00)

Explain whether or not the following situations meet the technical specification operability requirements. Assume modes one and two in all cases.

a. One ESF fan train is running for surveillance test purposes and the other train is in stop. [1.0]

b. The TD AFW pump speed governors are set at 50% to avoid an overspeed trip condition on automatic startup. [1.0]

c. The motor driven AFW pumps are intermittently started and stopped to maintain steam generator levels during plant startup. They are not placed in auto to avoid unwanted starts. [1.0]

QUESTION 8.03 (2.00)

During surveillance testing in the past year valving errors have resulted in the wrong train of ESF equipment being isolated. What administrative action has been taken to help reduce this problem?

QUESTION 8.04 (1.00)

Certain procedures must be 'in-hand' during the activity they are intended for. How are these identified?

QUESTION 8.05 (1.00)

The difference between temporary and permanent procedure changes is that permanent changes : (choose the correct answer)

a. require three seperate reviews whereas temporary changes only require two seperate reviews.

b. remain in affect until superceded whereas temporary changes are assigned an expiration date.

c. must be approved by a management representitive holding an SRO license whereas the temporary procedure may be approved by any SRO.

d. must be reviewed by the QA supervisor, PNSRC and plant manager whereas temporary procedures require only an SRO review.

QUESTION 8.06 (1.00)

Clearance permits are required for any work affecting safety of personnel or protection of property except: (choose the correct answer)

a. minor adjustments and troubleshooting by operations personnel or other cognizant personnel.

b. cases in which personnel are dispatched to guard all control or isolation points to prevent their operation.

c. in emergencies such that a delay to obtain a clearance permit would seriously prolong isolation of a component or a problem.

d. tasks performed in accordance with job orders or approved plant procedures.

QUESTION 8.07 (1.00)

Special instructions: (choose the correct answer)

a. are informational in nature.

b. automatically expire after six months.

c. can be used to supplement instructions or procedures.

d. may be issued by anyone.

QUESTION 8.08 (1.00)

In regards to CO-2 fire suppression: (choose the correct answer)

a. a fire watch is required whenever an area protected by CO-2 is occupied.

b. permission must be obtained from the control room prior to entering an area protected by CO-2.

c. the last person entering and leaving a protected area must disable and restore the CO-2 system.

d. routine repetitive work in protected areas is permitted without a fire watch being designated.

QUESTION 8.09 (1.00)

Access to the containment shall be: (choose the correct answer)

a. limited at all times except when the unit is in modes 5 or 6.

b. subject to the two-man rule except when the unit is in modes 5 or 6.

c. under the cognizance of the control room except when the unit is in modes 5 or 6.

d. subject to a radiation work permit except when the unit is in mode 5 or 6.

QUESTION 8.10 (1.00)

Termination of safety injection requires: (choose the correct answer) IAW 050 061

a. strict adherence to the emergency operating procedure criteria.

b. the approval of the unit supervisor.

c. the approval of the shift supervisor.

d. concurance of the shift technical advisor.

QUESTION 8.11 (2.00)

10 CFR 20 and 10 CFR 50 designates 15 types of events that must be reported to the NRC at once (within one hour). List five seperate events that require NRC notification within one hour. Note that listing more than one event that comes under the same heading or type will count as one.

QUESTION 8.12 (3.50)

a. Five reactivity anomolies or imbalances are listed in the T.S.(6.9.1.12) as requiring prompt notification with written followup. Provide three. [1.5]

b. What two allowances are made for exceeding surveillances? [0.5]

c. What action is required if an ACTION statement cannot be satisfied? [0.5]

d. The plant is in mode four with one RHR pump out of service. The maintenance foreman says that the pump will be repaired in two days. [1.0]
Explain why we can or can't do it in mode 3

QUESTION 8.13 (2.00)

a. Describe or explain the difference between the classes of emergencies at your site. [1.6]

b. Define or explain the following terms:
1. Technical Support Center
2. Exclusion Area [0.2 each]

QUESTION 8.14 (1.50)

a. Name those positions who may authorize entry into Extreme High Radiation Areas. [1.25]

b. What type(s) of Radiation Work Permit(s) may be issued for access to Extreme High Radiation Areas? [0.25]

QUESTION 8.15 (2.00)

How would you handle the following situations as a shift supervisor?

a. The plant is operating at 20% power when a RCP trip occurs without a reactor trip. [1.5]

b. While performing a surveilance test on control rods at 100% power it is discovered that none of the rods in bank D can be moved. [0.5]

$f = ma$

$w = mg$

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgn$

$V_f = V_o + at$

$W = \nu\ \Delta P$

$\Delta E = 931\ \Delta m$

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

$\dot{Q} = UA\Delta t$

$Pwr = W_f \Delta h$

$P = P_o 10^{sur(t)}$

$P = P_o e^{t/T}$

$SUR = 26.06/T$

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$T = (\ell^*/\rho) + [(\beta - \rho)/\lambda\rho]$

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\lambda\rho)$

$\rho = (K_{eff}-1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [(\ell^*/(T K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$P = (\Sigma\phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

$v = s/t$

$s = V_o t + 1/2\ at^2$

$a = (V_f - V_o)/t$

$w = \theta/t$

Cycle efficiency = (Network out)/(Energy in)

$A = \lambda N \qquad A = A_o e^{-\lambda t}$

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

$t_{1/2}^{eff} = \dfrac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$I = I_o e^{-\Sigma x}$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$M = 1/(1 - K_{eff}) = CR_1/CR_o$

$M = (1 - K_{effo})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-5}$ seconds

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

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$

$R/hr = (0.5\ CE)/d^2$(meters)

$R/hr = 6\ CE/d^2$ (feet)

Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
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 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 $lbf/in.^2$

Miscellaneous Conversions

1 curie = 3.7×10^{10} dps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 5.01 (2.00)

a. ACP lower than ECP

b. ACP same as ECP

c. ACP higher than ECP

d. ACP lower than ECP

e. ACP same as ECP [.4 each]

REFERENCE: Westinghouse Reactor Theory Review Text

ANSWER 5.02 (1.00)

a.

REFERENCE: Westinghouse Reactor Theory Review Text

ANSWER 5.03 (1.00)

d. -

REFERENCE: Thermal-Hydraulic Principles and Applications to PWR II

ANSWER 5.04 (1.00)

b..

REFERENCE: Thermal-Hydraulic Principles and Applications to PWR II, page 14-27

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 5.05 (2.00)

a. 1. To ensure a minimum amount of RCS subcooling is maintained. [0.5]
2. To ensure that RCS temperature is not too low for the existing RCS pressure to avoid brittle fracture. required for full credit [0.5]

b. 1. NC provides very little cooling for the reactor vessel head. [0.25]
2. The soak periods allow time for the head to cool and prevent void formation [0.75]
full credit for part 2

REFERENCE: 4023.001.008

ANSWER 5.06 (2.00)

a. 10 hours or 5 hours
b. 10 hours
c. 50 or 80 hours
d. 50 hours [0.5 each]

REFERENCE: Westinghouse Reactor Theory Review Text

ANSWER 5.07 (1.50)

a. disagree [0.5]

b. Thermal neutron flux will be highest in the coolant channel where fast neutrons are thermalized by the moderator. [1.0]

REFERENCE: Westinghouse Reactor Theory Review Text

ANSWER 5.08 (1.50)

The stream generator heat transfer rate equals that of the reactor because the heat is in the form of both sensible and latent so each pound of steam contains many times more energy than each pound of reactor coolant.

REFERENCE: Thermal-Hydraulic Principles and Applications to the PWR II

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 5.09 (2.00)

a. false
b. true
c. false
d. true [0.5 each]

REFERENCE: Thermal-Hydraulic Principles and Applications to the PWR II

ANSWER 5.10 (1.00)

b.

REFERENCE: Westinghouse Reactor Theory Review Text page I-4.15

ANSWER 5.11 (1.00)

d.

REFERENCE:Westinghouse Reactor Theory Review Text page I-3.10

ANSWER 5.12 (1.00)

a.

REFERENCE: Westinghouse Reactor Theory Review Text page I-5.10

ANSWER 5.13 (1.00)

c.

REFERENCE: Westinghouse Reactor Theory Review Text page I-5.10

ANSWER 5.14 (1.00)

d. C-E

REFERENCE: Westinghouse Reactor Theory Review Text page I-5.31

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 5.15 (1.00)

c.

REFERENCE: Westinghouse Reactor Theory Review Text page I-5.77

ANSWER 5.16 (1.00)

d.

REFERENCE: 4021.001.012 step 4.4

ANSWER 5.17 (1.00)

a.

REFERENCE:Technical Specifications 4.1.1.1.1.b.

ANSWER 5.18 (1.00)

c.

REFERENCE:Technical Specifications 3.2.4

ANSWER 5.19 (1.00)

b.

REFERENCE:Thermal-Hydraulic Principles and Applications PWR II pages 8-15

ANSWER 5.20 (1.00)

d.

REFERENCE:Thermal-Hydraulic Principles and Applications Pwr II pages 8-14

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 6.01 (1.00)

~~High differential pressure across the cooling coils caused by frost buildup.~~ ~~OR~~ time actuated. ~~either is fulfilled~~

REFERENCE: NS-14-27

ANSWER 6.02 (1.25)

~~stop closing and reopen due to the SI~~

The valve will ~~continue to close and after reaching the fully closed position will~~ reopen in response to the SI.

REFERENCE:NS-12-35

ANSWER 6.03 (2.00)

Yes it can. [0.5]

They are required to start on a loss of power to the busses from which the ESW pumps receive their power. Also a trip pressure [1.5]

REFERENCE:AS-2-14,AS-10-4

ANSWER 6.04 (3.00)

a. 1. Standby CCW pump starts.
   2. Standby CCW heat exchanger outlet valve opens.
   3. CCW to SFP heat exchanger is isolated.
   4. CCW to Letdown heat exchanger is isolated.
   5. CCW to Boric acid evaporator is isolated.
   6. CCW to Excess letdown heat exchanger is isolated.
   7. CCW to Reactor support coolers are isolated.
   8. RHR heat exchanger CCW outlet valves open.

b. items 3 through 7 above

c. 1. CCW to RCP's is isolated.
   2. CCW valve to air recirculation Hydrogen skimmer fans is opened.

REFERENCE:AS-1-20,21 [15 @ .2 each]

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 6.05 (1.25)

UNIT ONE: a. loss of speed feedback
b. loss of 250 vdc under 1800 rpm
c. loss of 24 vdc at 1800 rpm
d. low EH control pressure

UNIT TWO: a. high exhaust hood temperature

REFERENCE: PGS-4A-13,42; PGS-4B-11,37 [5 @ .25 each]

ANSWER 6.06 (1.50)

a. To isolate steam flow stored in the cross around system from the low pressure turbines to prevent turbine overspeeding. [1.0]

b. ~~50%~~ ~~60%~~ [0.5]

REFERENCE:PGS-2A-31, PGS-2A-35

ANSWER 6.07 (1.00)

a. phase A containment isolation
b. blowdown high radiation from NSS
c. blowdown treatment high radiation
d. high level in either blowdown flashtank
e. feedwater conservation signal

REFERENCE: PGS-1-26 [5 @ .2 each]

ANSWER 6.08 (3.00)

a. 1. allows additional flow through pump bearing [0.5]
2. generally during low pressure conditions [0.5]

b. 1. provides a backpressure to force flow through number 3 seal [0.5]
2. RCDT [0.5]

c. Diverts to the PRT through a relief valve [1.0]

REFERENCE: NS-3

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 6.09 (1.00)

1. main feedwater regulating valves trip shut
2. main feedwater isolation valves shut
3. main feedwater pumps trip
4. main feedwater pumps discharge valves shut

REFERENCE: PGS-10 [.25 each]

ANSWER 6.10 (1.50)

a. electronic overspeed

b. generator phase differential fault

c. manual pushbutton

REFERENCE: AS-10, PAGE 60 [1.50]

ANSWER 6.11 (2.25)

a. permits bridge motion with the gripper tube not at the top limit; bypasses the reverse travel limit switch

b. permits motion towards the the canal with the trolley out of the interlock zone; allows motion in any direction when the gripper tube is not at the top limit

c. permits trolley motion in either direction with gripper tube not at top limit; allows trolley motion when bridge is not in core or canal area

REFERENCE:NS-16-34 [.75 each]

ANSWER 6.12 (.75)

a. recirculate holdup tank contents

b. transfer holdup tank contents to another tank

c. transfer holdup tank contents to the spent fuel transfer canal

REFERENCE: NS-7-15 [.25 each]

ANSWER 6.13 (1.25)

Recombiners raise temperature of gases passing through them from containment causing hydrogen and oxygen to form moisture which is returned to containment.

REFERENCE: NS-15-3

ANSWER 6.14 (1.50)

a.1. containment pressure 2.9 psig 2/4
2. unit one: high steam flow [variable 2/4] + low steam line pressure [600 psig 2/4] or low-low Tave [541 degrees 2/4]

unit two: high steam flow [variable 2/4] + low-low Tave [541 degrees 2/4]; low steam line pressure [600 psig 2/4]

b. containment pressure 2.9 psig 2/4

REFERENCE: NS-11-81, 94-95

ANSWER 6.15 (1.00)

a. unit one or two air handler glycol temperature high
b. refrigeration compressor lockout or failure
c. unit one or two air handler glycol temperature low
d. refrigeration compressor oil temperature high
e. glycol circulating pump failure
f. glycol circulating pump discharge pressure low

REFERENCE: NS-14-49 accept all block 35 alarms [4 @ .25 each]

OR ~~Operating procedure OHP 4022.034.004 Steps 4.1 thru 4.7~~ A recombiner is started by placing its controls switch in run, adjusting the power supplied to its electric heaters, and monitoring the recombiner temperatures Ref. NS-15-39

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 6.16 (1.75)

a.1. Provides a high gain at low power and a low gain at high power for uniform ~~response~~ control of reactor [0.5]

2. ~~average~~ nuclear power and turbine power [0.5]
Averaged

b.1. 0 or 8 spm

2. 8 spm

3. 72 spm [.25 each]

NS-4

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 7.01 (1.00)

To satisfy assumptions made in the FSAR accident analysis of a rod withdrawal accident.

REFERENCE: 4022.002.001

ANSWER 7.02 (3.00)

a. 5 minutes
b. 30 minutes
c. 1. close seal injection needle valves
   2. cool down pump bearing at one degree per minute or less
d. 1. #1 seal leakoff > 6 gpm + other indications of failure
   2. #1 seal leakoff < .2 gpm + outlet temperature increasing
   3. #1 seal outlet flow > 185 F + flow decreasing
   4. #1 seal DP < 200 psid + high leakoff flow
   5. thermal barrier CCW temperature high annunciator + leakoff flow increasing
   6. RCP bearing temperature > 210 F
   7. RCP motor bearing temperatures > 200 F + other indications of bearing failure
   8. RCP vibration > 15 mils increasing rapidly or > 20 mils and increasing slowly
   9. RCP motor winding > 145 C
   10. CCW flow lost for two minutes
   11. CCW flow lost + seal water > 175 F
   12. CCW flow lost + leakoff > 200 F
   13. CCW flow lost + either motor bearing > 185 F

REFERENCE

REFERENCE : 4022.002.001

ANSWER 7.03 (2.00)

a. excessive control rod insertion
b. failure of a rod to drop during a reactor trip
c. uncontrolled cooldown
d. SDM less than required
e. Unexpected criticality

REFERENCE: 4022.005.002 [0.5 each]

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 7.04 (2.00)

a. Not before the RWST low level [.25] or when the lower containment level sump reaches 97% [.25] but before the RWST low-low level [0.5]

b. 20 hours [.25] to prevent excess boron concentration in the reactor vessel [.75]

REFERENCE: 4022.008.002

ANSWER 7.05 (2.50)

a. Verify all automatic actions and manually initiate any that have not occured.

b. Verify charging flow through the boron injection tank to the RCS.

c. Verify AFW flow to the SG's.

d. Verify that heat is being removed from the RCS by the SG's.

e. If phase B occurs verify main steam stop valves close and containment spray initiates.

REFERENCE: 4023.001.002, step 4.2 [.5 each]

ANSWER 7.06 (1.00)

d.

REFERENCE: 4021.001.001 step 4.1.15

ANSWER 7.07 (1.00)

a. When the dosimeter is greater than 20% of scale before entry into a controlled area.

b. When the dosimeter is at 80% of scale while in a high rad area.

REFERENCE: PMP 6010.RAD.001, page 61 [0.5 each]

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 7.08 (1.00)

b.

REFERENCE: 4021.001.001 step 4.1.1

ANSWER 7.09 (1.00)

a.

REFERENCE: 4021.001.001 step 6.10

ANSWER 7.10 (1.00)

a. 1.25 Rem per quarter
b. 1.0 Rem per quarter

REFERENCE: PMP 6010.RAD.001, page 36

ANSWER 7.11 (1.00)

c.

REFERENCE: 4021.001.003 step 4.19

ANSWER 7.12 (1.00)

b.

REFERENCE: 4021.001.004 step 4.2

ANSWER 7.13 (1.00)

a.

REFERENCE: 4021.001.004 step 4.12.1

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 7.14 (1.00)

a.

REFERENCE: 4021.001.004 step 4.16.3

ANSWER 7.15 (1.00)

a.

REFERENCE: 4021.001.004

ANSWER 7.16 (1.00)

d.

REFERENCE: 4021.002.003 steps 4.4 and 5,4.7,4.12

ANSWER 7.17 (2.00)

a. one wide range Th is less than 350 degrees

b. wide range RCS pressure is greater than 700 psig and stable or increasing

c. pressurizer water level is greater than 20 % of span and rising

d. RCS subcooling is at least 45 degrees using Th RTD's or 33 degrees using thermocouples

REFERENCE: 4023.001.005 step 5.2.6

ANSWER 7.18 (1.50)

a. PET if the TSC is activated

b. advisory support group if the EOF is activated

c. NRC

REFERENCE: 4023.001.015 step 2.5 [0.5 each]

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 8.01 (2.00)

With less than four loops operable above 541 degrees:

a. The RPS bistables from the affected loop must be tripped within one hour or [1.0]

b. The RCS temperature must be reduced below 541 degrees [1.0]

REFERENCE: LER and T.S. 3.3.1.1

ANSWER 8.02 (3.00)

a. No, since neither the train in test nor the train in off are operable.

b. No, since this setting would not allow for adequate flow or pressure in the event of an accident.

c. No, since they must be capable of automatic starting in these modes.

REFERENCE: LER, T.S.

ANSWER 8.03 (2.00)

The surveillance test for each train are now covered by seperate rather than common procedures. INDEPENDENT VERIFICATION AND

REFERENCE: LER

ANSWER 8.04 (1.00)

A double astrisk will appear before the procedure number.

REFERENCE: PMI-2010

ANSWER 8.05 (1.00)

b.

REFERENCE: PMI-2010

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 8.06 (1.00)
c.
REFERENCE: PMI-2110

ANSWER 8.07 (1.00)
a.
REFERENCE: PMI-2260

ANSWER 8.08 (1.00)
b.
REFERENCE: PMI 2270

ANSWER 8.09 (1.00)
c.
REFERENCE: PMI 4010

ANSWER 8.10 (1.00)
b. or c
REFERENCE: DSD 061

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 8.1 (2.00)

1. Events defined by 10 CFR 20 involving:
   a. radiation exposure to personnel.
   b. radioactive releases.
   c. loss of facility operations
   d. damage to property

2. Events defined by 10 CFR 50 involving:
   a. declaration of emergency classes
   b. plant shutdown required by technical specifications
   c. deviations from technical specifications in an emergency as necessary to protect the public health and safety.
   d. any serious degradation of the nuclear plant including it's principal safety barriers.
   e. unanalyzed conditions that significantly compromise plant safety.
   f. a condition that is outside the design basis of the plant.
   g. conditions not covered by the plant's operating and emergency procedures.
   h. any natural phenomenon or other external condition that poses a threat to plant safety or significantyly hampers site personnel in the performance of duties necessary for safe plant operation.
   i. any event that results or should have resulted in ECCS discharge to the RCS as a result of a valid signal.
   j. any event that results in a loss of emergency assessment capability, offsite response capability, or communications capability.
   k. any event that poses an actual threat to the plant safety or significantly hampers site personnel in the performance of duties necessary for the safe operation of the plant including fire, toxic gas releases or radioactive releases.

REFERENCE: 10 CFR 20.403 AND 10 CFR 50.72 [5 @ .4 each]

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 8.12 (3.50)

a.*. Imbalance between the predicted and actual steady state reactivity equal to or greater than 1%.
2. A shutdown margin less than specified in tech. specs.
3. Short term reactivity increases corresponding to less than a 5 second period.
4. Unplanned criticality.
5. Unplanned insertion of more than .5% of reactivity while subcritical. [3 @ .5 each]

per 10 CFR 50.73

b.1. Extention of a single interval by 25% of the specified interval. [.25]
2. Extension of three consecutive intervals by 325% of the specified interval. [.25]

c.1. hot stby in ~~one~~ 6 hours [.25]
2. cold shutdown in ~~30~~ 36 hours [.25]

3. satisfy action in 1 hour

d.1. Stay in mode four [.25]
2. Cannot enter a higher mode until LCO's for current mode are met. [.75]

otherwise

REFERENCE: TECH SPECS

ANSWER 8.13 (2.00)

a.1. unusual event: local action only; no threat to public;

2. alert: actual or potential degradation of plant safety; could affect public safety

3. site emergency: actual failure of plant functions needed to mitigate the events for protection of the public

4. general emergency: actual core damage with imminent potential for loss of containment integrity

b.1. Area close to CR where experienced personnel can provide technical support and assistance to plant operations.

2. Area within site boundary.

REFERENCE: EMERGENCY PLAN PROCEDURES

ANSWERS -- COOK 1&2 -85/02/26-T BURDICK

ANSWER 8.14 (1.50)

a. 1. Plant Rad Protection Supervisor
   2. Rad Protection Supervisor
   3. Shift Supervisor
   4. Technical Superintendent
   5. Duty Staff Supervisor [0.25 each]

b. only a regular RWP [0.25]

REFERENCE: PMP.6010.RAD.001, page 88

ANSWER 8.15 (2.00)

a. Perform a plant shutdown so as to be in at least hot standby in one hour. TRIP THE REACTOR IS OK

b. Determine that the shutdown margin requirement is satisfied within one hour and be in hot standby within six hours.

REFERENCE: TS 3.1.3.1, 3.4.1.1