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Question # 43

Unit 1

Given the following conditions:

- *The Unit is in Mode 5.*
- *A loss of RHR cooling occurred due to a loss of CCR.*
- *The RO reports that all CCR pumps are tripped.*
- *The crew is performing actions of AOP-1.10.1, Residual Heat Removal System Loss.*

Which ONE of the following describes the reason for monitoring RHR temperature at this time?

A. RHR temperature must be logged to determine time to RCS saturation.

B. RHR temperature must be logged to determine time available to vent RHR pumps.

C. If temperature exceeds 180°F, the RHR pumps must be tripped to prevent seal damage.

D. If temperature exceeds 180°F, the RHR pumps must be tripped to prevent cavitation.

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Discussion:

- The BVPS position is to accept two answers to this question; Answers "A" or "C". The original correct answer is "C".

- The initial conditions of the question stated a loss of RHR/RHS had occurred and did not state the status of the RHR/RHS pumps. The status of these pumps at the onset of the event is critical in determining the correct answer.

- The initial conditions of the question did however state that AOP 1(2).10.1, Residual Heat Removal System Loss, was being exercised. Four of the six Entry Conditions for this procedure are directly related to a loss of the running RHR/RHS pumps. The other two Entry Conditions address temperature issues, which could be related to a loss of the running pumps or could be due to the loss of cooling water (CCR/CCP).

- Additionally, the status of the RCS pressure and temperature were not listed in the stem of the question. What was listed was that the unit was in Mode 5 and that core cooling was lost. Under these conditions it is quite possible that RCS subcooling could be quickly lost, requiring the operator to stop the RHR/RHS pumps due to cavitation as directed by AOP 1(2).10.1, Residual Heat Removal System Loss, Step 6, Response Not Obtained (RNO).

- Based on the information provided in the stem of the question, the AOP entry conditions, and the AOP steps requiring the RHR/RHS pumps to be stopped if cavitating, there exists enough ambiguity that the status of the RHR/RHS pumps is indeterminate during this event.

- If the RHR/RHS pumps were operating throughout this event, answer "C" would be correct per AOP 1(2).10.1, Residual Heat Removal System Loss, step 9.c, Response Not Obtained (RNO) column.

- If the RHR/RHS pumps were NOT operating at the onset of the event, due to events other than power supply related problems, or if they were stopped during the event due to cavitation, answer "A" would be correct per AOP 1(2).10.1, Residual Heat Removal System Loss, steps 5.a.2) Response Not Obtained (RNO) and step 11.b.

- Answer "A" was originally stated as being incorrect because it stated that RHR/RHS temperature would not be monitored for time to saturation, RCS temperature would be monitored. However, from the initial conditions, RHR/RHS temperature would be indicative of RCS temperature as stated below.

    - In the question stem, a loss of all forced cooling flow (CCR/CCP) through the RHR/RHS Heat Exchangers exists. This would lead to the RHR/RHS Heat Exchanger inlet and outlet temperatures being the same as the bulk RCS temperature.

$$T_{RCS} = T_{RHR\ HX\text{-}in} = T_{RHR\ HX\text{-}out}$$

  - For this reason, RHR/RHS temperature, as stated in Answer "A", can be substituted for RCS temperature.

- Answers "B" and "D" are still incorrect as stated in the original exam submittal.

- From an operational and reactor safety perspective, the overall intent of the Loss of RHR/RHS procedure is to either restore reactor core cooling via the RHR/RHS system or establish an alternative means of cooling the reactor core. The necessity to establish an alternative means of core cooling is governed by the time to RCS saturation. Many of the candidates selected answer "A" based on this reactor safety perspective.

- It is for these reasons that for question #48, answers "A" and "C" should be accepted as being correct answers and "B" and "D" should be considered as incorrect answers.

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Question # 58

Given the following conditions:

- *The Unit is operating at 100% power, with all systems in NSA.*
- *The RO recognizes that Control Bank "D", Group 2, and Control Bank "B", Group 2 control rods drop just prior to a reactor trip.*

Which ONE of the following is the cause of the failure?

A. Logic Cabinet Oscillator failure

B. Logic Cabinet Master Cycler failure

C. Power Cabinet Thyristor failure

D. Power Cabinet Logic error

Discussion:

- The BVPS position is to accept two answers to this question; Answers "C" or "D". The original correct answer is "C".

- Answers "A" and "B" are wrong because they deal with a Rod Control "Logic Cabinet" failure which would affect all four power cabinets and thus, all control rods.

- Answer "C" is correct if more than one thyristor in Power Cabinet 2BD failed. The only thyristor failure that could cause rods to drop when rods are not being moved, is the failure of the Half Wave Phase Controlled Bridge Thyristor circuit in the Stationary Gripper section of the Power Cabinet. However, failure of a single thyristor will cause only a <u>single</u> group of rods to drop, not two groups as described in the stem of the question. Therefore, two or more thyristors must fail in order to drop two groups of rods. (Reference BVPS Operating Manual 1.1.5, Figure 1-46 and 2.1.5 Figure 1-44.)

- Answer "D" is also correct for the following reasons.

  A "Power Cabinet Logic Failure" occurs when a simultaneous control signal of zero amps is issued to both the stationary and movable gripper coils for one or more control rods. Such a current order command could cause the affected rod(s) to drop. (Reference 1OM-1.1.D, page 21, Failure Detectors, #3 and 2OM-1.1.D page 16, Failure Detectors, #3.)

By design however, the Power Cabinet "Urgent Failure" should actuate, and issue a hold current to the affected rods to prevent the rods from dropping, and actuate a control room annunciator (alarm). An Urgent Failure alarm was not listed in the initial conditions of the question.

Many of the candidates stated that when answering this question, they reflected on the instructions that were read to them from NUREG 1021 just prior to starting this exam. Specifically the following statement:

When answering a question, do not make assumptions regarding conditions that are not specified in the question unless they occur as a consequence of other conditions stated in the question. For example, you should not assume an alarm has activated unless the question so states or the alarm is expected to activate as a result of the conditions that are stated in the question. *(Reference NUREG 1021 Rev. 9, Appendix E, item 7, pg. 2 of 6)*

The candidates concluded from this statement, and the conditions stated in the stem of the question, that the Urgent Failure alarm was not active, nor did it activate prior to the reactor trip that was stated in the stem of the question.

Given then that the Urgent Failure alarm did not activate prior to the reactor trip, a Power Cabinet Logic Failure (zero current demand to the moveable and stationary gripper coils) could result in two groups of dropped rods.

- It is for these reasons that for question #54, answers "C" and "D" should be accepted as being correct answers and "A" and "B" should be considered as incorrect answers.

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Question # 67

Given the following conditions:

- *The Unit has been at 100% power for 3 weeks. All systems are in NSA.*
- *RCS boron concentration is 1000 ppm.*
- *A controlled power reduction to 50% is to be performed.*

Using the references provided and maintaining control rods at their current position, assuming no change in xenon concentration, which ONE of the following describes the approximate amount of boric acid required to initially maneuver the plant to 50% power?

A. 700 - 800 gallons

B. 850 - 950 gallons

C. 1000 - 1100 gallons

D. 1150 - 1250 gallons

Discussion:

- The BVPS position is to accept two answers to this question for the Unit 1 exam only, Answers “B” or “C”. The original correct answer is “C”.
- The answer to the Unit 2 exam should remain as-is because the calculated answer falls well within the desired range of the original correct answer.
- Answer “B” should be considered correct based on the tolerances and inaccuracies introduced to determine this answer. Specifically, in order to obtain an answer to this question, the candidate needs to read and obtain points from three different graphs, then interpolate two different logarithmic scales on a nomograph. It should also be noted that the candidates were NOT provided with a ruler to more accurately interpolate the logarithmic scales of the nomograph. The tolerances between the proposed correct answers (“B” or “C”) fall within the tolerances and margin of error obtained when calculating the correct answer to this problem.

- As indicated in the revised question explanation, the boron addition change equals approximately 135 ppm based on mathematical calculations from numbers derived from three different graphs. (Reference BVPS Curve Book curves; CB-21 – Power Defect vs. Percent Power, CB-13 – Critical Boron Concentration Vs Burnup, and CB-28 – Boron Worth Vs Burnup).

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- To determine the final answer, it is required to use a nomograph that has a combination of one linear and two logarithmic scales, The far left scale, PPM Boron In Coolant, is linear, and the two scales on the right, Boric Acid Volume and PPM Boron Addition, are logarithmic scales. (Reference BVPS Curve Book curve CB-31 – Boron Addition nomograph).

- It should be noted that the proper technique for reading a logarithmic scale is that half of the linear distance between two points on a logarithmic scale is equal to approximately one third of the delta between the two points, plus the initial point value. For example, given two points on a log scale of 100 and 200, half of the linear distance between these two points would equal approximately 133.

- Using curve CB-31, Boric Acid Addition nomograph, the desired boron addition of 135 ppm is plotted approximately one half of the linear distance between the values of 100 and 200 ppm on the far right logarithmic scale (PPM Boron Addition). Using 1000 ppm as the original RCS boron concentration (initial condition) on the far left scale (PPM Boron In Coolant), a line drawn between these two points results in the boric acid volume that needs to be added to the RCS, as read on the middle logarithmic scale of the nomograph (Boric Acid Volume).

- The point of intersection on the middle logarithmic scale (Boric Acid Volume) falls between the 900 and 1500 gallon marks. Since the scale is not graduated, an interpolation must be made. Using the thumbrule for logarithmic graph reading, half of the linear distance between these two points, results in a value of ~1100 gallons. It can now be seen that the point of intersection falls below the 1100 gallon point and above the 900 gallon point. One can now conclude then that the required amount of boric acid that needs to be added is between 900 and 1100 gallons.

- The difficulty now lies in trying to determine whether the required value is <950 gallons (Answer “B”) or >1000 gallons (Answer “C”). Because of the small size of the scale (~3/8 of an inch represents a difference of approximately 200 gallons, which is still on a log scale), the readability of this scale should be considered to fall within an acceptable margin of error to accept answers “B” or “C”.

- Additionally, the candidate needs to use three different graphs to obtain the desired boron concentration change (135 ppm) to plot on the far right column of the nomograph. Assuming a small error on reading each curve, the starting point on the nomograph of 135 ppm will have some numerical tolerance in addition to the interpolation tolerance.

- The intent of the question was to evaluate the candidates ability to calculate the amount of boric acid addition for a given power change. By choosing

either answer “B” or “C” this knowledge and ability is demonstrated to be within an acceptable margin of error as explained above.

- It is for these reasons that for question #67 (Unit 1 only), answers “B” and “C” should be accepted as being correct answers and “A” and “D” should be considered as incorrect answers.

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- **Question # 74**

*During the performance of EOP actions, the crew observes a **NOTE** prior to Step 1 of the EOP, and a **CAUTION** prior to Step 3 of the EOP.*

Which ONE of the following describes the applicability of these statements during the performance of the EOP?

A. *The NOTE is applicable throughout the entire procedure. The CAUTION applies to Step 3 ONLY.*

B. *The NOTE applies to Step 1 ONLY. The CAUTION applies to Step 3 ONLY.*

C. *The NOTE is applicable throughout the entire procedure. The CAUTION applies to all steps of the procedure that succeed it.*

D. *The NOTE applies to Step 1 ONLY. The CAUTION applies to all steps of the procedure that succeed it.*

Discussion:

- The BVPS position is to accept two answers to this question; Answers "A" or "C". The original correct answer is "A".
- The BVPS Emergency Operating Procedures (EOP) Executive Volume Users Guide states the following in reference to cautions and notes; (Reference 1/2OM-53B.2 pg. 2)

CAUTIONS contain information about potential hazards to personnel or equipment. They also advise on actions or transitions which may become necessary depending on changes in plant conditions.

In general, NOTES and CAUTIONS apply to the step which they precede. A NOTE or CAUTION which precedes the first operation action step may also apply to the entire procedure.

- **Answer "A" -** *"The NOTE is applicable throughout the entire procedure. The CAUTION applies to Step 3 ONLY"* can be broken down into two distinct statements.
  - **Answer "A" first statement:** *"The NOTE is applicable throughout the entire procedure."* This statement is supported by the 2nd sentence of the 2nd statement from the BVPS EOP Executive Volume Users Guide and

from the examples contained in Attachment 1, NOTE's At The Beginning Of EOP's.

Attachment 1, NOTE's At The Beginning Of EOP's, contains the first page of all BVPS Emergency Operating Procedures that contain a NOTE prior to step one. In reviewing these NOTE's, it is evident that in ALL cases, the NOTE's apply throughout the entire procedure. In the cases where the NOTE refers to step 1 for starting a Reactor Coolant Pump (RCP), Step 1 is a continuous action step, and is therefore applicable throughout the entire procedure, making the NOTE also applicable throughout the entire procedure.

- **Answer "A" second statement:** "*The CAUTION applies to Step 3 ONLY"* is supported by the 1st sentence of the 2nd statement from the BVPS EOP Executive Volume Users Guide and from the examples contained in Attachment 2, Cautions Applicable To Specific Steps.

  Attachment 2, Cautions Applicable To Specific Steps, contains examples of CAUTION's used in the BVPS EOP's. In reviewing these CAUTION's, it is evident that they are only applicable to the steps that they precede.

- For these reasons, the answer "A" is correct.

- **Answer "C"** - *"The NOTE is applicable throughout the procedure. The CAUTION applies to all steps of the procedure that succeed it."* can also be broken down into two distinct statements.
  - **Answer "C" first statement:** *"The NOTE is applicable throughout the procedure."* This statement is correct as described above for answer "A".
  - **Answer "C" second statement:** "*The CAUTION applies to all steps of the procedure that succeed it."* is supported by portions of the 1st and 2nd statements from the BVPS EOP Executive Volume Users Guide, and from the examples contained in Attachment 3, Cautions Applicable To All Subsequent Steps.
    - The specific parts of the BVPS EOP Executive Volume Users Guide statements identified above are:

    "They also advise on actions or transitions which may become necessary depending on changes in plant conditions."

    And

    "A NOTE or CAUTION which precedes the first operation action step may also apply to the entire procedure"

    - Attachment 3, Cautions Applicable To All Subsequent Steps, contains examples of CAUTION's used in the BVPS EOP's. In reviewing these

CAUTION's it is evident that they are applicable throughout the remainder of the procedures being performed.

- For these reasons, answer "C" is also correct.

- Answers "B" & "D" both contain the statement: *"The NOTE applies to step 1 ONLY"*.

  - This statement is incorrect as described above in **Answer "A" first statement**.

  - Therefore Answers "B" and "D" are clearly incorrect.

- It is for these reasons that for question #74, answers "A" and "C" should be accepted as being correct answers and "B" and "D" should be considered as incorrect answers.