Vermont Yankee
NRC Initial Operator Exam
Review Comments on Written Exam Questions

Question # 33

This question requires the candidate to determine the proper procedural response, given a set of post-accident plant conditions, where ECCS suction strainer plugging begins to occur with two "A" Loop RHR pumps injecting to maintain RPV level. The question states:

Following a transient the following plant conditions exist:

- RHR pumps 'A' and 'C' are injecting to the vessel maintaining RPV level above 127 inches with the RHR-27A, Outboard Injection Valve, throttled.
- RHR pump 'B' is in torus cooling.

The operators then determine that the suction strainer for RHR pumps 'A' and 'C' are becoming plugged by debris.

In accordance with the station procedures the operators should:

A. Secure either RHR pump 'A' or 'C' and leave the idle pump's discharge valve open so that the running pump flow can backwash the filter.
RHR pump 'B' should be left in Torus cooling.

B. Secure either RHR pump 'A' or 'C' and commence injection to the RPV with RHR pump 'B'.

C. Secure either RHR pump 'A' or 'C', if not required to maintain adequate core cooling.

D. If possible, place RHR Loop 'A' in Torus cooling and use RHR pumps 'B' and 'D' to maintain RPV level.

The correct response listed on the exam answer key is response "C". This response is predicated upon the candidates applying the requirements of ON 3164, ECCS Suction Strainer Plugging, whose Operation Actions state:

1. Remove from service or throttle flow from those ECCS systems not needed to restore and maintain EOP parameters.

    a. Consider securing one of two running RHR pumps within a single loop.

The justification written in the answer key for this question states that response "C" is "Correct per the procedure. OPPP-7018, Attachment 9, EOP 1, Section 6, Rev. 15, page 18 & 19: The flowcharts, to ensure compliance with VY's design basis, prohibit exceeding NPSH limits in any procedure steps that would be used during a design basis accident. Both RHR A & C [pumps] are not required to maintain adequate core cooling if RHR-27A is throttled."

Due to the lack of specific values in the stem of the question for Torus temperature & pressure and for RHR flows there is no way to determine the specific NPSH constraints. However, given the existence of ECCS Loop "A" suction strainer plugging, operators would need to be mindful of a potential challenge to NPSH requirements for the RHR pumps. They would therefore need to limit RHR flows and ensure continued torus cooling.

When procedural guidance from ON 3164 is applied for the ECCS suction strainer plugging situation described in this question, the candidates were expected to select response "C". This would result in securing either RHR Pump "A" or "C", if not required to maintain adequate core cooling. Response "C" requires the candidate to determine that two pumps are not required to maintain adequate core cooling based on the stem of the question which states that the RHR-27A valve is throttled closed and RPV level is being maintained above 127". The stem of the question does not state to what extent RHR-27A is throttled nor does it give a specific RPV level trend. Not having this information makes it difficult to conclude whether securing one pump will ensure adequate core cooling can be maintained over the long term. For the short term, with RPV level at ≥ 127", there should be adequate time to secure either the RHR Pump "A" or "C" and determine if one pump could maintain adequate core cooling. Additionally, with this approach RHR Pump B would still be in service providing torus cooling. Therefore, the procedural direction of ON 3164 to "remove from service or throttle flow from those ECCS systems not needed to restore or maintain EOP parameters" would be met for at least a short term duration (i.e. RPV Level and Torus temperature would be maintained) with response "C".

In a similar manner, response "D" would also meet the procedural direction of ON 3164 to "remove from service or throttle flow from those ECCS systems not needed to restore or maintain EOP parameters" (i.e. RPV Level and Torus temperature would be maintained). Response "D" would have the operators place RHR Loop "A" in Torus Cooling and use RHR Pumps "B" and "D" to maintain RPV level. Using this approach, **both long and short term RPV level control is assured** because it is known that two RHR pumps will maintain level ≥ 127", regardless of how much or how little the injection valve was previously throttled on the "A" RHR loop. Vermont Yankee has two ECCS suction strainers, one that supplies ECCS Loop "A" and one that supplies ECCS Loop "B". They are located in opposite sections of the Torus. The stem of the question does not state that the "B" ECCS suction strainer is becoming plugged with debris and therefore RHR Pumps "B" and "D" could be placed in service on a clean suction strainer and aligned in injection mode to ensure the continuation of adequate core cooling. Additionally, the stem of this question does not mention any condition which would preclude the availability of RHR Loop "A" valves for alignment in torus cooling mode. Restoration of torus cooling is required to ensure that adequate NPHS is maintained to support the operation of the two Loop "B" RHR pumps which are needed to maintain adequate core cooling.

Given these plant conditions, re-aligning RHR Loop "A" from injection to torus cooling mode would be accomplished during Attachment 6 of OPOP-RHR-2124. The first two steps of Attachment 6 state:

1. IF a step cannot be completed for any reason, THEN **COMPLETE** the step as fully as possible and continue.
2. **PLACE** A and D RHR pumps OR B and C RHR pumps in PULL TO LOCK.

Step 2 of Attachment 6 would have the operators secure either the "A" or "C" RHR Pump in a timely manner. Either action ensures that ECCS Loop "A suction strainer plugging concerns would be addressed in a timely manner as required by Step 1 of ON 3164.

It should also be noted that Response "A" for this question is incorrect because there is no direction in ON 3164 to leave the discharge valve for the idle RHR pump open so that the flow from the running pump can backwash the suction filter.

Response "B", which states "Secure RHR pump "A" or "C" and commence injection to the RPV with RHR pump "B"", is also incorrect. It is incorrect because it fails to meet the requirement of ON 3164 "to restore or maintain EOP parameters". Using one Loop "A" RHR Pump and one Loop "B" RHR pump for RPV injection will ensure adequate core cooling for the stated plant conditions but effectively eliminates Torus cooling. Torus cooling was previously in service on RHR Loop "B" and should be maintained to ensure NPSH requirements for the RHR pumps continues to be met in light of suction strainer plugging concerns.

Given this information, Vermont Yankee is proposing that both 'C' and 'D' be accepted as correct responses to Question # 33 since either of these responses will ensure that the concerns of ECCS suction Strainer Plugging are addressed in accordance with ON 3164 by securing one RHR pump in Loop "A" and reducing flow in that loop while ensuring that EOP parameters for RPV level and torus temperature control are effectively restored or maintained.

Question # 45

This question requires the candidate to diagnose the status of an SRV to determine what action must be taken in accordance with OPOT-3121-01, Inadvertent Opening of a Relief Valve. The question as written states:

Analyze the following:

- **Torus temperature is 73°F and rising 2°F/5 min**
- **RPV level has dropped about 1 inch**
- **Generator MWe load has dropped 10 MWe**
- **Steam flow is 2% LOWER than indicated feed flow**
- **'C' SRV tailpipe temperature reads 242°F and rising slowly**
- **"RX RELIEF VLV OPEN" alarm (CRP 3-A-1) is not illuminated**
- **"RX RELIEF/SAFETY VLV TEMP HI" alarm (CRP 3-B-4) is illuminated**

Your required actions are to:

A. Place torus cooling in service as required to maintain temperature.

B. Cycle the 'C' SRV control switch from AUTO to OPEN to AUTO.

C. Place the ADS APPENDIX R BYPASS Switch in BYPASS.

D. Pull the associated control power fuses for the 'C' SRV.

During the administration of this exam one candidate asked the proctor for clarification regarding whether multiple responses may be correct for this question. The proctor told the candidate that all pertinent information was contained in the question and offered no clarification. The candidate was directed to answer the question as written.

The correct response listed on the exam answer key for this question is response "A". This answer is predicated upon the candidates concluding that the relief valve is leaking based upon the conditions stated in the stem of the question and then concluding that the torus cooling must be placed in service to maintain temperature as directed by Step 3.4.1 of the applicable procedure OPOT-3121-01, Inadvertent Opening of a Relief Valve, which reads as follows:

3.4 IF an SRV is determined to be leaking (i.e., not open), THEN:

3.4.1 Place Torus cooling in service as needed per OP 2124, Residual Heat Removal System.

However, the plant conditions given in the stem of the question when compared to the procedure symptoms are not wholly conclusive. The governing procedure does not offer a clear set of plant conditions to diagnose whether an SRV is leaking as opposed to it being partially open. Therefore a determination that the SRV is either leaking or open is very subjective.

OPOT-3121-01, Inadvertent Opening of a Relief Valve, lists the following symptoms to identify a leaking or open SRV:

1.1 **Identify leaking or open SRV by observing the following:**

- 1.1.1 **"RX RELIEF/SAFETY VLV TEMP HI" alarm (CRP 3-B-4).**
- 1.1.2 **"RX RELIEF VLV OPEN" alarm (CRP 3-A-1).**
- 1.1.3 **SRV indicator lights CRP 9-3.**
- 1.1.4 **RPV level decrease of up to approximately 7 inches for a full open SRV.**
- 1.1.5 **Steam Flow/Feed Flow mismatch of up to approximately 10% for a full open SRV.**
- 1.1.6 **Generator load reduction up to approximately 10% (for a fully open SRV) or bypass valve closure.**
- 1.1.7 **Increasing Torus temperature (initial Torus temperature increase of up to approximately 15°F in the first 5 minutes for a full open SRV).**
- 1.1.8 **Increasing tail pipe temperature trend on PLC-2-166, RPV/SV/RV screen (CRP 9-21) or ERFIS W094, W095, W096 or W097 without a corresponding Drywell temperature increase.**
- 1.1.9 **ERFIS normalized tail pipe temperatures indicated by computer point C106, C107, C108 or C109 in alarm state. (INS9523_06)**

It would be reasonable to conclude that the SRV is leaking based on some of the plant conditions listed in the stem of this question when compared to the above listed procedural symptoms. For instance, the presence of Annunciator 3-B-4, "RX RELIEF/SAFETY VLV TEMP HI" in the absence of Annunciator 3-A-1, "RX RELIEF VLV OPEN" would lead some operators to conclude that the SRV is merely leaking and therefore actions should be taken in accordance with Follow-Up Action Step 3.4.1 to place torus cooling in service to limit the rise in torus temperature. (i.e. Response A is correct.)

However, the stem of this question also gives values for some plant parameters that would lead other operators to reasonably conclude that the SRV, although not full open, was open significantly enough to warrant taking actions for an open SRV.

- For instance the question's stem states: "Steam flow is 2% LOWER than indicated flow". From the symptoms listed Step 1.1.5 above, a 2% mismatch between Steam Flow/Feed Flow can be used to estimate that the SRV is 20% open.
- The stated torus temperature "rising 2°F/5 min" would lead an operator to conclude the valve is approximately 13% open based on a torus temperature rise of 15°F/5 min for a full open SRV as stated in Step 1.1.7.
- The stated RPV level drop of 1" would lead an operator to conclude the valve is approximately 14% open based on an RPV level drop of 7" for a full open SRV as stated in Step 1.1.4.

Based on these estimates these operators would conclude that the valve is partially open, not just leaking, and the actions of OPOT-3121-01 for a stuck open SRV need to be performed. They would reasonably conclude that Follow-Up Action Step 3.4.1 needs to be implemented to cycle the SRV's control switch to attempt to close the partially open valve. (i.e. Response B is correct.)

Given this information, Vermont Yankee is proposing that both 'A' and 'B' be accepted as correct responses to Question #45 since the operators could make a determination that the valve was either leaking or open based on the lack of unambiguous diagnostic steps in the governing operational transient procedural OPON-3121-01.

NRC RESOLUTION OF POST EXAM COMMENTS

Reactor Operator Question 33

Following a transient the following plant conditions exist:

- RHR pumps 'A' and 'C' are injecting to the vessel maintaining RPV level above 127 inches with the RHR-27A, Outboard Injection Valve, throttled.
- RHR pump 'B' is in torus cooling.

The operators then determine that the suction strainer for RHR pumps 'A' and 'C' are becoming plugged by debris.

In accordance with the station procedures the operators should:

A. Secure either RHR pump 'A' or 'C' and leave the idle pump's discharge valve open so that the running pump flow can backwash the filter. RHR pump 'B' should be left in Torus cooling.

B. Secure either RHR pump 'A' or 'C' and commence injection to the RPV with RHR pump 'B'.

C. Secure either RHR pump 'A' or 'C', if not required to maintain adequate core cooling.

D. If possible, place RHR Loop 'A' in Torus cooling and use RHR pumps 'B' and 'D' to maintain RPV level.

The correct answer was choice C.

The facility proposed that choice D was also a correct response. Per choice D, operators would realign the RHR system, per Attachment 6 of Operating Procedure (OP) -RHR-2124, Residual Heat Removal System, such that RHR Loop 'A' (consisting of RHR pumps A and C) would be switched from vessel injection mode to torus cooling mode, and RHR Loop 'B' (consisting of RHR pumps B and D) would be switched from torus cooling mode to vessel injection mode.

NRC Response

The comment is not accepted. The question describes a post-transient situation where suction strainer plugging is occurring in RHR Loop A, which is the Loop currently aligned for vessel injection. The governing procedure for strainer plugging is Off Normal (ON) procedure 3164, ECCS Suction Strainer Plugging. Step 1 of that procedure directs the operator to:

> Remove from service or throttle flow from those ECCS systems not needed to restore and maintain EOP parameters.

The next step of ON 3164 directs the operator to:

> Consider securing one of two running RHR pumps within a single loop.

The only answer choice that complies with procedure ON 3164 is choice C. There is no direction in the ON to realign the RHR system as described in choice D. While VY staff is certainly correct that Attachment 6 of OP-RHR-2124 is used to place an RHR Loop in torus cooling, the Attachment does not address strainer plugging - and strainer plugging is the primary, immediate concern. Furthermore, if an operator did place Loop A in torus cooling, as suggested in choice D, without first correcting that Loop's strainer plugging, he would simply trade the challenge to vessel injection for a similar challenge to torus cooling, i.e., strainer plugging would then potentially jeopardize torus cooling.

The question is deemed valid as originally written, and therefore the correct answer remains only choice C.

Reactor Operator Question 45

Analyze the following:

- Torus temperature is 73°F and rising 2°F/5 min
- RPV level has dropped about 1 inch
- Generator MWe load has dropped 10 MWe
- Steam flow is 2% LOWER than indicated feed flow
- 'C' SRV tailpipe temperature reads 242°F and rising slowly
- "RX RELIEF VLV OPEN" alarm (CRP 3-A-1) is not illuminated
- "RX RELIEF/SAFETY VLV TEMP HI" alarm (CRP 3-B-4) is illuminated

Your required actions are to:

A. Place torus cooling in service as required to maintain temperature.

B. Cycle the 'C' SRV control switch from AUTO to OPEN to AUTO.

C. Place the ADS APPENDIX R BYPASS Switch in BYPASS.

D. Pull the associated control power fuses for the 'C' SRV.

The correct answer was choice A.

The facility staff proposed that choice B was also a correct response. They contended plant conditions are ambiguous regarding C safety relief valve (SRV). Therefore, the candidates could conclude the SRV is more than merely leaking, and, although not full open, is open far enough to warrant taking action as though the valve was indeed full open. Therefore, the actions described in choice B - actions required for an open, not leaking SRV - would be appropriate.

NRC Response

The comment is not accepted. This question describes a condition related to an SRV malfunction, and hinges on the candidate's ability to determine whether the SRV is leaking by (i.e., not open) or has inadvertently opened, and take the actions for that determination. The governing procedure is Operational Transient (OT)-3121-01, Inadvertent Opening of a Relief Valve. To identify a leaking or open SRV, the procedure directs the operator to observe (among others), the following:

"RX RELIEF/SAFETY VLV TEMP HI" alarm (CRP 3-B-4).

"RX RELIEF VLV OPEN" alarm (CRP 3-A-1).

RPV level decrease of up to approximately 7 inches for a full open SRV.

Steam Flow/Feed Flow mismatch of up to approximately 10% for a full open SRV.

Generator load reduction up to approximately 10% (for a fully open SRV).

Increasing Torus temperature (initial Torus temperature increase of up to approximately 15°F in the first 5 minutes for a full open SRV).

Increasing tail pipe temperature trend.

If the SRV is leaking (i.e., not open), the operator continues in the procedure down one path; if an SRV is open, the operator continues in the procedure down a different path.

All symptoms given in the question stem, whether assessed individually or in the aggregate, consistently indicate the SRV is not open. In particular, stem condition "'RX RELIEF VLV OPEN" alarm (CRP 3-A-1) is not illuminated' tells the candidate the valve is not open. So, to take the action described in choice B - the action for an open SRV - is procedurally incorrect. Instead, the operator is to take action for a leaking (i.e., not open) SRV, and that action is described in choice A.

The question is deemed valid as originally written, and therefore the correct answer remains only choice A.