Memorandum

To: Mr. Todd Fish, USNRC Region I

From: Thomas Wooley, FENOC

Date: 10/18/02

Re: BVPS Unit 1 NRC Exam

Enclosed is the submittal package for the BVPS Unit 1 NRC written exam administered on October 11, 2002 as required by ES-501, Section C.1.

The initial results were twelve (12) of fourteen (14) candidates passed the written exam. Two (2) SRO candidates scored 76% and 78% respectively. This submittal includes recommended answer key changes to six (6) of the exam questions.

If you have any questions or require further information, please call me at (724) 682-5723, Mr. Tom Gaydosik at (724) 682-1879, or Mr. Chris Hynes at (724) 682-5751.

1LOT5 NRC Exam
Answer Key Changes

Question #2

Recommendation:

Change the Answer Key to accept 'B' or 'C' as a correct answer.

Basis:

The question asks for the response of the CVCS system following a dropped control rod event from 100% power. According to the Answer Key, the correct answer is 'C' [Charging flow is increased]. However, distractor 'B' [Letdown flow is decreased] is also correct. Both of these responses were validated post-exam on the BVPS Unit 1 Simulator and are plotted on the attached parameter printout.

The original answer - "Charging flow is increased" is correct due to the effects on RCS temperature and Pressurizer pressure when a single control rod is dropped into the core with the unit remaining on-line. As RCS Tavg lowers, Pressurizer pressure also decreases. As RCS pressure lowers, charging flow increases due to the characteristics of centrifugal pump flow. Charging flow continues to increase until the pump's flow control valve has a chance to respond to the change in the Pressurizer level control error signal.

In addition to the response of charging flow to a drop in RCS pressure, the effects of a dropped control rod also impact letdown flow. The drop in RCS pressure causes the differential pressure across the CVCS letdown orifice to also decrease, which in turn causes a reduction in letdown flow. This question required recognizing that a reduction in RCS pressure (~ 235 psig) results in a reduction in letdown flow, that in turn leads to a lower charging flow, as the charging flow control valve compensates to reduce makeup to the RCS.

Given the effect that a dropped control rod has on RCS pressure and letdown differential pressure which affect both charging and letdown flow, then both 'B' and 'C' are considered to be acceptable answers to this question.

1LOT5 NRC Exam
Answer Key Changes

Question #3

Recommendation:

Change the Answer Key to accept 'C' as the correct answer.

Basis:

The question asks for the required actions related to a low Reactor Coolant Pump (RCP) bearing oil reservoir condition. The revision of the alarm response procedure (REACT COOL PP BRG OIL RESERVOIR LEVEL LOW) used to develop this question directed actions to trip the reactor based upon the plant mode of operation. In Mode 3, per the stem initial conditions, a reactor trip was not warranted. Since the time of the question development and validation, the alarm response procedure has been revised and now refers the operator to take actions in accordance with abnormal operating procedure 1OM-53C.4.1.6.8, Abnormal RCP Operation.

The AOP addresses actions to be taken for various RCP problems and directs the operator to trip the reactor in any situation, regardless of plant mode, where conditions require the RCP to be stopped.

For conditions related to low bearing oil reservoir levels, the AOP directs the operator to consult with plant management to determine if a plant shutdown is necessary. This option was not specified as a choice in any of the distractors.

Distractor 'D' included the option to secure the RCP, but was incorrect due to an implausible pump bearing temperature limit. The other three distractors all included the option to trip the RCP; however, distractor 'A' did not include tripping the reactor, which is no longer correct per the new AOP guidance. Only distractor 'C' contained the combination of actions (trip the reactor, enter EOP E-0, and trip the RCP) that correctly answers the question.

The AOP guidance for securing a RCP directs the operator to trip the reactor, perform the immediate actions of E-0, Reactor Trip or Safety Injection and then trip the RCP. This is the appropriate action to take with the plant in Modes 1 - 3 and is correct based upon the training received by the license candidates.

1LOT5 NRC Exam
Answer Key Changes

Question #17

Recommendation:

Change the Answer Key to accept two correct answers, 'A' or 'C'.

Basis:

This question asked the candidate's to evaluate the response of the core exit thermocouple (CET) temperatures following a reactor trip and trip of all RCP's (natural circulation conditions) given that all systems operate as designed. A validation of the plant response to the question conditions was analyzed using the BVPS Unit 1 Simulator and is provided in the attached parameter graphs.

Two assumptions are necessary to correctly answer the question.

The first is the amount of time that passes after the RCP's are tripped. If a short time frame is assumed, i.e., less than 30 minutes, then a second assumption regarding the mode of operation of the condenser steam dump valves is also necessary. If the steam dump valves operate in the "Tavg" mode, then plant response is adversely affected due to their undesired operation resulting from a lag in RCS temperature response during natural circulation conditions. However, if the steam dump valves operate in the "Steam Pressure" mode, then plant response differs as the steam dump valves are able to more effectively control RCS temperature.

At BVPS, the operators are required to take pre-emptive action to place the steam dump valves in the "Steam Pressure" mode in the event of a loss of forced flow (all RCP's are stopped) in order to more effectively control RCS temperature. This is documented in the BVPS - EOP Executive Volume User's Guide (excerpt attached) which lists the actions that are allowed to be performed early in order to stabilize plant parameters.

In the "Steam Pressure" mode the expected plant response is that CET temperatures will initially rise and then stabilize at a value corresponding to the steam dump valve controlling pressure. Refer to Graph #1 parameter trace. This would lead to selecting 'C' as the correct answer.

In the "Tavg" mode, the expected response is that CET temperatures will initially rise and then drop as stated in answer 'A'. Refer to Graph #2 parameter trace.

However, if a long time frame, i.e., greater than 1 hour is assumed, regardless of the status of the condenser steam dump mode of operation, then as natural circulation is established temperature will drop as the core decay heat load decreases. This also would lead to selecting 'A' as the correct answer.

Due to the absence of information related to time frame and the condenser steam dump valve mode of operation, this question can be correctly answered by either 'A' or 'C'.

1LOT5 NRC Exam
Answer Key Changes

Question #35

Recommendation:

Change the Answer Key to accept two correct answers, 'A' or 'B'.

Basis:

The question evaluated the ability to calculate the amount of boric acid needed to reduce reactor power from 100% to 50% without inserting control rods and required a determination of the MINIMUM amount of boric acid in gallons. Depending on the accuracy and interpolation applied in reading the plant curves, the calculated answer will vary. When the value determined by performing the calculation is transposed to a corresponding value on the boron addition nomograph (plant curve CB-31) it is near the distinct increment of 900 gallons. Based on readability and accuracy of the curves, a value slightly higher or lower than 900 gallons could be obtained.

The nomograph used for the exam is incremented between 1000 and 1500 ppm for RCS boron concentration and between 100 and 150 ppm for the boron addition change. This requires interpolating between two sets of incremental numbers.

Using the information provided in the question and attached references, the calculated boron concentration is128 ppm. This number must then be interpolated between the increments of 100 and 150 ppm. Depending on the accuracy of this interpolated point and the point of initial boron concentration (1100 ppm), the amount of boric acid addition may be determined as slightly above or below 900 ppm.

If the amount of boric acid is determined to be less than 900 gallons, then distractor 'A' is the most correct. If greater than 900 gallons, then distractor 'B' (1100 gallons) is the most correct answer for the MINIMUM amount of boric acid needed.

The calculation did not result in a clearly correct answer between these two distractors in part because the question asked for the "MINIMUM" amount.

Due to the acceptable tolerances in locating interpolated values on the nomograph curve, both 'A' and 'B' are considered to be correct answers.

1LOT5 NRC Exam
Answer Key Changes

Question #57 (SRO)

Recommendation:

Change the Answer Key to accept two correct answers, 'B' or 'C'.

Basis:

This question asked the candidate to evaluate a set of conditions to determine which would cause a control rod to be declared inoperable per Technical Specifications LCO 3.1.3.1 (attached). This was not an open reference question relying upon memory knowledge of the Technical Specification and operation of the Rod Control System.

At BVPS, Technical Specification LCO 3.1.3.1 states that the control rods are considered operable when positioned within ± 12 steps of the rods in a group (indicated position vs. demand position). Further, the action statements in the LCO address conditions where control rod(s) are also considered inoperable if found to be immovable due to friction or mechanical interference, untrippable, or trippable but inoperable due to other causes.

The original answer 'C' is correct since it satisfies the action statement condition in which a control rod is trippable, but inoperable due to other causes (cannot be moved electrically).

Distractor "B" states that the Rod Bottom light for a single rod was not lit following a reactor trip. The alarm response procedure for "ROD BOTTOM ROD DROP" applies to the condition of a control rod with a rod bottom light extinguished and lists the setpoint as 20 steps off the bottom. If the Rod Bottom light is not lit after a reactor trip the candidate must assume that the rod is more than 20 steps off the bottom, unless information in the question or answer indicate that the indication is invalid. This assumption is consistent with the information provided in "NUREG 1021, Appendix E item #7" (see attached). There is no such information contained in the question stem or distractors.

Therefore the candidate must assume that the rod is >20 steps off the bottom and > than 12 steps from the rest of the group which would render the rod inoperable. Although the Technical Specification is not applicable in the current mode the Rod would still be declared inoperable and tracked as such.

Given that the original answer, 'C' and distractor 'B' are valid conditions for declaring a control rod inoperable, both are considered to be correct answers.

Question #72 (SRO)

Recommendation:

Change the Answer Key to accept two correct answers, 'A' or 'C'.

Basis:

This question tested the candidate's ability to evaluate plant conditions related to implementing the Loss of Secondary Heat Sink procedure. In particular this question tested the knowledge requirement of the method of re-establishing auxiliary feedwater flow to the steam generators (SG's) after performing a feed and bleed of the RCS.

Given the information contained in the question stem and applying the guidance of Step 28 of EOP FR-H.1, "Response to Loss of Secondary Heat Sink", the actions specified in answer 'A' and distractor 'C' would both be performed.

This is demonstrated by following the step through its performance. The original answer 'C' is arrived at by beginning at substep 'a' of Step 28 and working through to substep 'c' using the information provided in the question. By satisfying the criteria for RCS temperatures greater than 520°F (588°F and rising) and all SG wide range levels less than 13% (all offscale low) the next action is contained in substep 'c' to establish flow to one SG not to exceed 100 gpm. This is the endpoint considered as the correct answer when the question was developed and validated.

However, since RCS feed and bleed was previously established per the question conditions, then the fact that RCS temperature is given as 588°F and rising slowly implies that the feed and bleed was not effective in lowering RCS temperature.

Because RCS temperature is not decreasing as would be expected through the addition of 100 gpm of auxiliary feedwater flow to one SG, then this also is considered as ineffective. Substep 'd' of Step 28 checks that core exit temperatures are stable or dropping. If not, then the next action is to feed one SG at the maximum feed flow available according to the Response Not Obtained column of substep 'd'.

In following the procedure flowpath to a logical end in accordance with the information provided in the question, then both the original answer 'C' and distractor 'A' can be considered as correct answers.