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

EXAMINATION REPORT - 50-338 AND 339/OL-89-01

Facility Licensee: Virginia Electric and Power Company
P. O. Box 16666
Richmond, VA 23261

Facility Name: North Anna Power Station

Facility Docket Nos.: 50-338 and 50-339

Facility License Nos.: NPF-4 and NPF-7

Examinations were administered at North Anna Power Station near Mineral, Virginia.

Chief Examiner: _____ 13 JUNE 1989
J. A. Hildsen Date Signed

Approved By: _____ for 6/15/89
Ken E. Brockman, Chief Date Signed
Operator Licensing Section 2

SUMMARY

Examinations were administered on May 8 - 12, 1989.

Written examinations and operating tests were administered to two SRO and eight RO applicants. All SROs and ROs passed these examinations.

REPORT DETAILS

1. Facility Employees Contacted:

*M. Allen, Lead Instructor - RO
*M. Crist, Supervisor - Training
*B. Delamorton, Supervisor - Simulator Training
*L. Edmonds, Superintendent, Nuclear Training
*G. Kane, Station Manager
*J. Stall, Superintendent of Operations
*R. Starr, Lead Instructor - SRO

*Attended Exit Meeting

2. Examiners:

R. Aiello, NRC
*J. Arildsen, NRC
S. Carrick, PNL
D. Faris, PNL
R. McWhorter, NRC
L. Sherfey, PNL
R. Starkey, NRC
R. Vinther, PNL

*Chief Examiner

3. Exit Meeting:

At the conclusion of the site visit, the examiners met with representatives of the plant staff to discuss the results of the examinations. There were no generic weaknesses noted during the operating tests.

The examiners made the following observations concerning the North Anna training program.

a. Manual leak rate calculation, PT-52.2, does not specify an alternative source of data other than the computer.

b. Twice during the examination visit, members of the Health Physics Department told examiners that the alarm set point for friskers was set at 100 counts above background. This was incorrect. Examiners and candidates noted frisker alarms set at greater than 100 counts above background.

c. In general, RO candidates demonstrated noteworthy knowledge in the areas of Technical Specifications and procedures.

The pre-examination facility technical review of the written examinations proved beneficial.

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

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

revised Key

Nuclear Regulatory Commission
Operator Licensing
Examination

This document is removed from
Official Use Only category on
date of examination.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION
REGION 2

FACILITY: North Anna 1 & 2

REACTOR TYPE: PWR-WEC3

DATE ADMINSTERED: 89/05/08

INSTRUCTIONS TO CANDIDATE:

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	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
24.00	23.94	_____	_____	4. REACTOR PRINCIPLES (7%) THERMODYNAMICS (7%) AND COMPONENTS (10%) (FUNDAMENTALS EXAM)
33.00	32.92	_____	_____	5. EMERGENCY AND ABNORMAL PLANT EVOLUTIONS (33%)
43.25	43.14	_____	_____	6. PLANT SYSTEMS (30%) AND PLANT-WIDE GENERIC RESPONSIBILITIES (13%)
100.2		_____ FINAL GRADE	_____ %	TOTALS

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

_____
Candidate's Signature

QUESTION 4.01 (1.00)

ASSUME reactor power is 80%, 1200 ppm boron, and the control rods are in manual. 20 gallons of boric acid are then added to the RCS. Assuming no other operator action is taken and that xenon has no effect, WHICH ONE (1) of the following describes the affect on the reactor. (1.0)

(a.) Reactor power decreases then returns to 80% because the T/G load was not changed.

(b.) Tave decreases then returns to its original value as reactor power returns to 80%.

(c.) Reactor power decreases then returns to a value greater than 80% due to a new MTC.

(d.) Tave decreases then returns to a higher than original value due to the decrease in steaming rate caused by the Tave decrease.

ANSWER 4.01 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 86.2, Section V, Objective E.

192008K120 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.02 (1.00)

WHICH ONE (1) of the following describes WHY the moderator temperature coefficient becomes more negative from BOL to EOL? (1.0)

(a.) A decrease in the fuel to clad gap over core life results in a decrease in fuel temperature.

(b.) Boron concentration is reduced during core life to maintain power and as the core ages fission product poisons build up.

(c.) Plutonium build up over core life results in more fissionable material being available to compete with boron atoms for neutrons.

(d.) B-eff will become smaller over core life due to increased Pu-239 production which as a smaller delayed neutron fraction.

ANSWER 4.02 (1.00)

(b.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 86.2, Section 2, Objective C.

192004K106 ..(KA's)

QUESTION 4.03 (2.00)

An incident at Arkansas Nuclear One resulted in fuel damage when a control rod was found to be 90 inches further in the core than the remaining rods in its group for a period of 12 days. The rod was withdrawn to align it with the rest of the group within one hour while the plant continued to operate at 100% power. WHY is fuel damage likely to occur in such a situation? (2.0)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.03 (2.00)

Fuel in the vicinity of the inserted rod experiences lower Xenon and Iodine concentrations due to flux depression [+0.5]. When the rod was pulled back into position flux in the region increased [+0.5]. Xenon burns out rapidly in the higher flux [+0.3]. This results in severe power peaking in that region [+0.7].

(partial credit of less than 1 point for answers saying the rest of the core at higher power due to flux suppression in region with stuck rod).

REFERENCE

1. North Anna: Instructor Guide, NCRODP 86.2, Section 4, Objective C, p. 4.17.

192005K110 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.04 (2.00)

The reactor has a stable startup rate (SUR) of 0.7 decades per minute (DPM) at BOL.

a. WHICH ONE (1) of the following BEST approximates how long it will take after passing 100 watts to reach 5 mega watts? (1.0)

(1.) 4.7 minutes

(2.) 6.7 minutes

(3.) 8.7 minutes

(4.) 9.7 minutes

b. If the same amount of excess reactivity that resulted in a 0.7 DPM SUR at BOL was added to the reactor at EOL, WHICH ONE (1) of the following would be the resultant SUR? (1.0)

(1.) 0.5 DPM

(2.) 0.6 DPM

(3.) 0.8 DPM

(4.) 0.9 DPM

ANSWER 4.04 (2.00)

a. 2 [1.0]

b. 4 [1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 86.1, Section 8 & 9, Objectives.

192003K106 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.05 (1.00)

Unit one is operating at 85% power with rods in auto, when the operator borates 100 pcm. Shutdown margin will do WHICH ONE (1) of the following? (1.0)

(a.) increase

(b.) increase until rods move

(c.) decrease

(d.) remain unchanged regardless of rod movement

ANSWER 4.05 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 86.2, Section 9.

192002K114 ..(KA's)

QUESTION 4.06 (1.00)

In order to maintain a minimum 200 deg F. subcooling margin in the RCS when reducing RCS pressure from 2200 to 1500 psia, steam generator pressure must be reduced to approximately WHICH ONE (1) of the following? (1.0)

(a.) 200 psia

(b.) 245 psia

(c.) 260 psia

(d.) 275 psia

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.06 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 83, Section 5, Objective E,
2. STEAM TABLES

193003K125 ..(KA's)

QUESTION 4.07 (3.00)

a. STATE the Technical Specification bases for limits on heat flux and nuclear enthalpy hot channel factors FQ(Z) and FN delta-h. (1.0)

b. WHAT are the FOUR (4) operating conditions that must be met to ensure hot channel factor limits are maintained? (2.0)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.07 (3.00)

a. FQ(2) and FN delta-h ensure design limits on peak local power density [+0.25] and minimum DNBR [+0.25] are not exceeded and ensure LOCA peak fuel clad temperature will not exceed 2200 deg F. (ECCS acceptance criteria) [+0.5]. (Partial credit of up to +0.25 will be given for answer stating prevention of Tsat in any coolant channel.)

b. 1. Control rod in a single group move together with no individual rod insertion differing by more than +/- 12 steps from the group demand position.

2. Control rod groups are sequenced in overlapping groups.

3. RILS are maintained.

4. Axial power distribution (AFD) is maintained in limits.

[+0.5] each

REFERENCE

1. North Anna: Technical Specifications 3/4.2.2 and 3/4.2.2, "Heat Flux and Nuclear Enthalpy Hot Channel Factors."

2. North Anna: Instructor Guide, NCRODP 86.3, Section 3, Objective E.

193009K107 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.08 (1.00)

WHICH ONE (1) of the following errors would cause INDICATED reactor power to be higher than ACTUAL reactor power when used in a hand calorimetric? (After NIs have been adjusted.) (1.0)

(a.) Actual feed temperature is less than indicated feed temperature.

(b.) Measured steam generator pressure is 30 psig lower than actual steam generator pressure.

(c.) Measured feedflow is lower than actual feedwater flow.

(d.) If no provision were made for steam generator blowdown in progress.

ANSWER 4.08 (1.00)

(b.) [1.0]

REFERENCE

1. North Anna: Instructor Guide, NCROOP 83, Section 6.

193007K106 ..(KA's)

QUESTION 4.09 (1.00)

WHICH ONE (1) of the following actions will increase North Anna's thermodynamic efficiency? (1.0)

(a.) Increasing component cooling water flow to the letdown Hx.

(b.) Lowering condenser vacuum from 29" to 25".

(c.) Removing a high pressure FW heater from service.

(d.) Increasing power from 25% to 100%.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.09 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide NCRODP 83, Section 6, pp. 6.21-6.27, Objective H.

193005K103 ..(KA's)

QUESTION 4.10 (1.00)

WHICH ONE (1) of the following is NOT an example of a condition which causes water hammer? (1.0)

(a.) sudden closure of a valve in a system in which there is water flow

(b.) cavitation occurring at a flow orifice in a closed system

(c.) rapid pressurization of an otherwise stable solid system

(d.) starting a pump on a partially empty system

ANSWER 4.10 (1.00)

(c.) [+1.0]

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide NCRODP-83; Thermodynamics, Fluid Flow, and Heat Transfer; Section VIII; Learning Objective J.

193006K104 ..(KA's)

QUESTION 4.11 (1.50)

STATE TWO (2) advantages of a counterflow heat exchanger. (1.5)

ANSWER 4.11 (1.50)

1. The delta-T at any one point is constant reducing thermal shock.

2. The heat exchanger can be made smaller than a parallel flow Hx, cost saving.

3. The outlet temperature of the cold fluid can approach the highest temperature of the hot fluid.

4. A smaller delta t can be maintained for the same heat transfer area thereby generating less entrophy due to the heat transfer area.

Any two [+0.75]; max. [+1.5]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 83, Section X, p. 10.8.

191006K107 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.12 (2.50)

a. STATE the criteria for subsequent reactor coolant pump restarts if the motor has failed to achieve full speed on an initial or subsequent attempts. (1.5)

b. WHAT is the basis for this criteria? (1.0)

ANSWER 4.12 (2.50)

a. 1. Motor must be allowed to stand idle for at least 30 minutes.[+.75]

2. Within a two hour period the number of starts should be limited to three (3) with at least 30 minutes idle time between restarts. [+.75]

b. This criteria allows motor windings to cool [+0.5] preventing damage to winding insulation. [+0.5]

REFERENCE

1. North Anna: 1-OP-5.2, "Reactor Coolant Pump Operations," Precautions and Limitations.

191005K106 ..(KA's)

QUESTION 4.13 (1.00)

WHICH ONE (1) of the following will decrease available Net Positive Suction Head (NPSH)? (1.0)

(a.) Increase the temperature of the fluid entering the pump.

(b.) Pressurize the system increasing pressure of the pump suction.

(c.) Limit the flow through the pump or throttle the discharge valve.

(d.) Increase the height of the fluid above the pump suction.

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

ANSWER 4.13 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCROWP 83, Section 8, p. 8.18, Objective D.

191004K106 ..(KA's)

QUESTION 4.14 (1.00)

The plant has experienced a loss of coolant accident (LOCA) with degraded safety injection flow. The reactor coolant pumps (RCPs) are manually tripped and the resulting phase separation causes the upper portion of the core to uncover (core is slightly uncovered, ~10%).

WHICH ONE (1) of the following describes excore source range (BF3) neutron level indications following the core uncovering relative to the indications just prior to the core uncovering? (1.0)

(a.) significantly less neutron level

(b.) significantly greater neutron level

(c.) essentially unchanged neutron level

(d.) impossible to estimate with the given core conditions

ANSWER 4.14 (1.00)

(c.) [+1.0]

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide NCRODP-95.2, Mitigating Core Damage, Learning Objective D, Nonhomogeneous Voiding.

191002K117 ..(KA's)

QUESTION 4.15 (1.50)

Unit 1 is at 100% when steam pressure transmitter PT 475 (Ch III) fails low. STATE HOW and WHY the steam generator steam flow signal is affected. (1.5)

ANSWER 4.15 (1.50)

The steam flow signal will decrease (approximately 25%) [+0.5]. PT 475 provides density compens on [+0.5] to generate an accurate steam flow mass flow rate [+0.5].

REFERENCE

1. North Anna: Instructor Guide, NCRODP 93.12, p. 1.7 and H1.10, p. 3, Objective E.

191002K102 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.16 (1.50)

Technical Specification 3.7.1, "Safety Valves," allows operation in Modes 1, 2, and 3 with one or more main steamline code safety valves inoperable provided that within four (4) hours either the inoperable valves are restored to operable status or the Power Range Nuclear Flux High Setpoint is reduced per Table 3.7-1.

Maximum Number of Inoperable Safety Valves on Any Operating Steam Generator	Maximum Allowable Power Range Neutron Flux High Setpoint (Percent of RATED THERMAL POWER)
1	87
2	65
3	44

WHAT is the basis for allowing continued operation under these conditions? (1.5)

ANSWER 4.16 (1.50)

[By reducing the Power Range Neutron Flux High Setpoint] reactor power is limited to be less than the thermal power [+0.75] required to produce steam flow in excess of the relieving capacity of the most restrictive loop [+0.75].

REFERENCE

1. North Anna: Technical Specifications, 3.7.1.1, and Bases.

191001K101 ..(KA's)

(***** CATEGORY 4 CONTINUED ON NEXT PAGE *****)

QUESTION 4.17 (1.00)

WHICH ONE (1) of the following CORRECTLY completes the sentence:

"In the condensate system, the operating point for two pumps operating in parallel with be at _____ as compared to the operating point when one is operating and the other isolated." (1.0)

(a.) the same flow and the same discharge pressure

(b.) a higher flow rate and the same discharge pressure

(c.) a higher flow rate and an increase in discharge pressure

(d.) the same flow rate and an increase in discharge pressure

ANSWER 4.17 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCROOP 83, Section 8, Objective E.

191004K109 ..(KA's)

(***** END OF CATEGORY 4 *****)

QUESTION 5.01 (2.50)

a. Following a LOCA, a shift is made to hot leg recirculation. For WHICH pipe break location is hot leg recirculation necessary? (As per Emergency Operating Procedure bases.) (0.5)

b. HOW long after the event is the transfer to hot leg recirculation made? (0.5)

c. WHAT are TWO (2) benefits of hot leg recirculation? (1.5)

ANSWER 5.01 (2.50)

a. cold leg break [+0.5]

b. 10 hours after event initiation [+0.5]

c. Removes boron from fuel surfaces [+0.75]. Sweeps steam from reactor vessel head [+0.75].

REFERENCE

1. North Anna: Instructor Guide, NCRODP 95.4, Emergency Operation Procedures, pp. 9.2-9.4, Objective D.

2. North Anna: Instructor Guide, NCRODP 95.2, Mitigating Core Damage, B.11 and 12.

000011K313 ..(KA's)

QUESTION 5.02 (2.00)

Technical Specifications 3.7.1.5 requires main steam trip valves (MSTV) be operable and close within five (5) seconds.

WHAT are TWO (2) bases for this protection? (2.0)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.02 (2.00)

To minimize the positive reactivity effects of the RCS associated with the blowdown [+1.0]. Limits pressure rise in containment in the event the steamline rupture occurs within containment [+1.0].

REFERENCE

1. North Anna: Technical Specifications 3/4.7.1.5 and Bases.

2. North Anna: Instructor Guide, NCRODP 95, Transient and Accident Analysis, Section Objective.

000040K301 ..(KA's)

QUESTION 5.03 (1.50)

ECA-0.0, "Loss of All AC Power," mandates tripping the turbine as an immediate action. LIST, by priority, operator actions per ECA-0.0, if the turbine trip push buttons fail to trip the turbine. (1.5)

ANSWER 5.03 (1.50)

1. Place both EHC pumps in P-T-L.
2. Manually runback turbine.
3. Close MSTV's and bypass valves.

[+0.25] each for content
[+0.25] each for order
Max. [+1.5]

REFERENCE

1. North Anna: ECA-0.0, "Loss of All AC Power," p. 2.

000055K302 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.04 (1.00)

ECA-0.0, "Loss of All AC Power," mandates depressurization of the intact steam generators as quickly as possible but also stipulates maintaining the steam generator's pressure greater than 130 psig.

WHAT is the basis for the minimum pressure? (1.0)

ANSWER 5.04 (1.00)

Minimum pressure is required to prevent introduction of accumulator nitrogen into the RCS [+0.5] which would impede natural circulation [+0.5].

REFERENCE

1. North Anna: Instructor Guide, NCRODP 95.5, p. 1.9.

000055A202 ..(KA's)

QUESTION 5.05 (1.00)

WHICH ONE (1) of the following describes the CORRECT action to be taken when TWO (2) rods have dropped into the reactor? (1.0)

(a.) If the reactor did not trip, reduce power to less than 50%.

(b.) Manually trip the reactor and go to EP-0, "Reactor Trip or Safety Injection."

(c.) Check the power range nuclear instruments for quadrant power tilts.

(d.) Stabilize Tave at the present Tref with rods in manual.

ANSWER 5.05 (1.00)

(b.) [+1.0]

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: 1-AP-1.4, "Dropped Rod," p. 3.

000003K304 ..(KA's)

QUESTION 5.06 (1.00)

WHICH ONE (1) of the following CORRECTLY completes the sentence?

Upon failure of a number one (1) reactor coolant pump (RCP) seal the affected RCP's No. 1 seal leakoff valve ... (1.0)

(a.) "... should be closed within 5 minutes and the pump stopped within 30 minutes."

(b.) "... should be opened within 5 minutes and the pump stopped within 30 minutes."

(c.) "... should be closed within 5 minutes and the pump stopped within 60 minutes."

(d.) "... should be opened within 3 minutes and the pump stopped within 60 minutes."

ANSWER 5.06 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide 88.1, Section 3, Objective E.

2. North Anna: 1-AP-33, Reactor Coolant Pump Seal Failure.

000017A210 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.07 (1.00)

WHICH ONE (1) of the following statements CORRECTLY completes the sentence?

During an ATWS (Anticipated Transient Without Scram) WITH a loss of feedwater the operator should .... (1.0)

(a.) "... leave the main turbine on line to provide a heat sink for the RCS."

(b.) "... trip the main turbine to initiate a reactor trip."

(c.) "... leave the main turbine on line to reduce RCS pressure."

(d.) "... trip the main turbine to prevent steam generator dryout."

ANSWER 5.07 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: NCRODP 95.6, "Function Restoration Procedures," p. 1.6, Section Objective.

000029K306 ..(KA's)

QUESTION 5.08 (2.50)

According to ES 1.1, Attachment 1, "Natural Circulation Verification," WHAT are FIVE (5) conditions that would support or indicate natural circulation flow? INCLUDE both the parameter AND its expected condition. ASSUME containment conditions are normal. (2.5)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.08 (2.50)

1. RCS subcooling based on core exit Tc [+0.25] > 30 deg F or (80 deg F) [+0.25]

2. SG pressure [+0.25] stable or decreasing [+0.25]

3. RCS Th [+0.25] stable or decreasing [+0.25]

4. Core exit Tc's [+0.25] stable or decreasing [+0.25]

5. RCS cold leg temperature [+0.25] at Tsat for steam generator pressure [+0.25]

REFERENCE

1. North Anna: ES-1.1, Attachment 1, "Natural Circulation Verification."

2. North Anna: NCRODP 95.2, Mitigating Core Damage, Section 1, Post Accident Core Cooling, Section Objective C, Natural Circulation.

000055A202 (KA's)

QUESTION 5.09 (3.00)

a. STATE the immediate actions of FRP-S.1, "Response to a Nuclear Power Generation/ATWS," that are designed to add negative reactivity to the core. INCLUDE actions to be taken if the expected response is not obtained. (2.0)

b. STATE the basis for ensuring RCS pressure is < 2335 psig as it relates to FRP-S.1 immediate actions. (1.0)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.09 (3.00)

a. 1. Manually trip the reactor. [+0.5]
Manually insert control rods. [+0.5]

2. Initiate emergency boration of the RCS. [+0.5] --OR--
a. Verify charging/SI pump (one) running. [+0.2]
b. Place BATP in fast speed. [+0.2]
c. Open MOV-1350. [+0.1]

3. Inject the BIT. [+0.5] --OR--

Valves Open	Valves Closed
RWST Suction MOV 1115 B&D [+0.1]	VCT Suction MOV 1115 C&E [+0.1]
BIT Outlet MOV 1867 C&D [+0.1]	BIT Recirculation TV 1884A,B,&C [+0.1]
BIT Inlet MOV 1867 A&B [+0.1]	

b. Pressure > 2335 would inhibit boration of the RCS. [+1.0]

REFERENCE

1. North Anna: 1-FRP-S.1, "Response to a Nuclear Power Generation/ATWS."

2. North Anna: Instructor Guide, NCRODP 95.6, Section 1, p. 1.7.

000029K312 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.10 (1.00)

Technical Specifications 3.5.4, "Boron Injection Tank," specifies limits on minimum boron concentration and volume in the Boron Injection Tank (BIT). WHICH ONE (1) of the following accidents is used as the basis for these limits? (1.0)

(a.) An RCS cooldown caused by inadvertent depressurization.

(b.) A loss of coolant accident.

(c.) A main steamline rupture.

(d.) A continuous rod withdrawal accident.

ANSWER 5.10 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Technical Specifications 3.5.4 and Bases.

2. North Anna: Instructor Guide, NCRODP 95.3, Section I.

000040G004 ..(KA's)

QUESTION 5.11 (1.50)

WHAT are the SIX (6) operator immediate actions for a fire at the North Anna Power Station as per Abnormal Procedure 1-AP-50, "Fire Protection - Operations Response?" (1.5)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.11 (1.50)

1. sound fire alarm (for 10 seconds).

2. announce, using the intercom, "Fire! Fire! Fire! at (give location)!" (PA announcement)

3. repeat announcement

4. sound fire alarm (for 10 seconds)

5. repeat announcement

6. dispatch (a knowledgeable) individual from operations to the scene of the fire (to assist stations loss prevention representative/scene leader in assessing the situation)

[+0.25] each

REFERENCE

1. North Anna: Abnormal Procedure 1-AP-50, Fire Protection - Operations Response, p. 2 of 5, 8/29/85.

000067G010 ..(KA's)

QUESTION 5.12 (1.50)

DEFINE Inadequate Core Cooling (ICC). (1.5)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.12 (1.50)

1. High temperature condition in the core [+0.5] such that operator action is required [+0.5] to cool the core before damage occurs. [+0.5]

-OR-

2. > 5 Core Exit Thermocouple (CET) greater than or equal to 1200 deg F [+0.5] or CET's > 700 deg F [+0.5] RIVLIS < 46% [+0.5].

(Will accept either #1 or #2 answers); max [+1.5]

REFERENCE

1. North Anna: NCRODP 93.19, p. 1.9, Terminal Objective.

000074G011 ..(KA's)

QUESTION 5.13 (3.00)

Unit 2 has experienced a small break LOCA. The foldout page on EP-0 contains RCP tripping criteria.

a. WHAT is the RCP trip criteria? (Include conditions for adverse containment.) (2.0)

b. WHAT are the TWO (2) basis for NOT tripping the RCP's prior to meeting the RCP trip criteria? (1.0)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.13 (3.00)

a. Charging/SI pumps[+0.5], at least one running [+0.5] -AND- RCS subcooling based on CET < 25 deg F[+0.5] or 70 deg F for adverse containment [+0.5].

b. Without SI or charging pumps running [+0.25] the RCP's continue to provide core heat removal via the break [+0.25]

RCP operation during a small break LOCA does not lead to excessive inventory loss until the time when tripping would cause the core to uncover [+0.25]. (Since the break will not be uncovered until voiding has occurred in the RCS and voiding would occur first at the core exit), it is not necessary to trip RCP's as long as subcooling exists [+0.25].

REFERENCE

1. North Anna: NCRODP 95.4, p. 18, Section Objective C.

2. North Anna: 2EP-0, p. 11.

3. North Anna: NCRODP 95, p. 4.9 and T.4.1

000009K323 ..(KA's)

QUESTION 5.14 (1.50)

WHAT are FIVE (5) different symptoms/systems that indicate the presence of a steam generator tube rupture according to EP-3, "Steam Generator Tube Rupture?" (1.5)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

ANSWER 5.14 (1.50)

1. Increase in steam generator narrow range level.

2. Steamflow/feedflow mismatch.

3. N-16 radiation monitor alarm.

4. High radiation from any SG steamlines:

   ASG RI MS 270 (will accept any one (1) of
   BSG RI MS 271 these monitors)
   CSG RI MS 272

5. High radiation from any steam generator blowdown:

   ASG 2 RMSS 22 (will accept any one (1) of
   BSG 2 RMSS 223 these monitors)
   CSG 2 RMSS 224

6. High radiation from any steam generator sample.

7. Increasing count rate on the air ejector sample.

Any five (5) for [+0.3] each; max. [+1.5]

REFERENCE

1. North Anna: Instructors Guide, NCRODP 95.4, pp. 11.3 and 11.4.

2. North Anna: 2-EP-3, "Steam Generator Tube Rupture."

000038A202 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.15 (2.50)

Concerning a steam generator tube rupture:

a. HOW is overfill prevented? (0.75)

b. HOW can steam generator overfill lead to an increase in release rate of iodine nuclides? (0.75)

c. Besides an increase in iodine release rates, NAME TWO (2) other potential problems associated with steam generator overfill. (1.0)

ANSWER 5.15 (2.50)

a. Leak termination by reduction of RCS pressure to less than secondary pressure. [+.75]

b. Steam or liquid discharged through a secondary relief will flash to steam releasing iodine nuclides to the atmosphere

-OR-

Liquid spilled on the ground will evaporate having the same affect.

(Either answer) [+.75]

c. 1. Excess weight could break main steamline.
2. Water can damage the turbine driven AFW pump.
3. Water hammer and slug flow could damage main steamline.

Any two (2) [+0.5] each; max. [+1.0]

REFERENCE

1. North Anna: NCRODP 95, "Transient and Accident Analysis," p. 5.24, Section Objective 4

000038K301 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.16 (1.50)

a. WHAT is the Technical Specification safety limit for reactor coolant system pressure? (0.5)

b. WHICH ONE (1) of the following actions must be taken if the RCS pressure safety limit has been exceeded? (ASSUME Mode 1 conditions) (1.0)

(1.) Be in hot standby with RCS pressure less than the limit in 30 minutes.

(2.) Reduce RCS pressure to a value less than the limit in five (5) minutes and be in hot standby within the next 30 minutes.

(3.) Reduce RCS pressure to a value less than the limit in 30 minutes and be in hot standby within the next 60 minutes.

(4.) Be in hot standby with RCS pressure less than the limit within 60 minutes.

ANSWER 5.16 (1.50)

a. 2735 psig [0.5]

b. (4.) [+1.0]

REFERENCE

1. North Anna: Technical Specifications, 2.0, p. 2-1.

000027A204 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.17 (2.00)

WHAT are FOUR (4) of the six MAJOR FUNCTIONS that will be affected by a loss of instrument air in containment as stated in AP-28, Loss of Instrument Air. Include operating and shutdown conditions. (2.0)

ANSWER 5.17 (2.00)

1. RCS pressure control [+0.5] -OR-
   - Pzr spray valves
   - Pzr PORV's if N2 lost

2. RCP cooling [+0.5] -OR-
   - stator or thermal barrier

3. Loss of containment cooling [+0.5] -OR-
   - chilled water to CTMT recirculation fans
   - CC to CRDM fans
   - CTMT air recirculation fan and CRDM fan air operated dampers

4. Loss of RCS letdown [+0.5] -OR-
   - normal, RHR to letdown, and excess letdown

5. RCS temperature control [+0.5] -OR-
   - CC to RHR Hx
   - RHR bypass flow
   - RHR Hx outlet

6. Disc pressurization control [+0.5]

ANY ONE (1) minor function in each MAJOR FUNCTION for [+0.5] for that MAJOR FUNCTION

MAXIMUM [+2.0]

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: 1-AP-28, "Equipment and Parameter Considerations for Loss of Instrument Air," p. 2-4.

000065K303 ..(KA's)

QUESTION 5.18 (2.00)

WHAT are the FOUR (4) conditions requiring stoppage of all work and immediate evacuation of containment according to the precautions and limitations in 1-OP-4.1, "Controlling Procedure for Refueling?" (2.0)

ANSWER 5.18 (2.00)

1. "Hi Flux at Shutdown" alarm (actuated by fuel movement). [+0.5]

2. Loss of audible neutron countrate (< two tones per minute) with fuel in the core. [+0.5]

3. The station evacuation alarm sounds. [+0.5]

4. Evacuation is announced over the station intercom. [+0.5]

REFERENCE

1. North Anna: 1-OP-4.1, p. 11.

000036G001 ..(KA's)

(***** CATEGORY 5 CONTINUED ON NEXT PAGE *****)

QUESTION 5.19 (1.00)

WHICH ONE (1) of the following will cause FCV-488, feedwater regulating valve for 1B Steam Generator to move in the closed direction? (1.0)

(a.) a leak on the high pressure tap of the feed flow sensing device.

(b.) closure of FCV-1489, feed reg. bypass valve with FCV 488 in automatic.

(c.) a leak on the low pressure tap of the feed flow sensing device.

(d.) a leak on the upstream side of FCV-488 while in automatic.

ANSWER 5.19 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 93.12 Section Objective E.

000054K303 ..(KA's)

(***** END OF CATEGORY 5 *****)

QUESTION 6.01 (1.50)

In addition to an alarm on thermal barrier component cooling high or low flow, each pump has an annunciator "RCP XX Component Cooling Return Low Flow." WHAT are the THREE (3) signals AND setpoints that would activate this alarm? (1.5)

ANSWER 6.01 (1.50)

1. Upper bearing lube oil cooler discharge flow [+0.25] < 140 gpm (+/-10gpm) [+0.25].

2. Either stator cooler discharge flow [+0.25] < 100 gpm (+/-10gpm) [+0.25].

3. Lower bearing lube oil cooler discharge flow [+0.25] < 3 gpm (+/-0.5gpm) [+0.25].

REFERENCE

1. North Anna: Instructor Guide, NCRODP 92.6, p. 2.15, Objective A.

003000K404 ..(KA's)

QUESTION 6.02 (3.00)

Automatic and manual rod control is inhibited by reactor protection system interlocks. STATE the interlocks that would inhibit MANUAL rod withdrawals. INCLUDE setpoints and coincidence. (3.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.02 (3.00)

1. high power range [+0.25] at 103% [+0.25] 1 of 4 channels [+0.25].

2. overpower delta T [+0.25] at 3% below calculated reactor trip setpoint [+0.25], 2 of 3 channels [+0.25].

3. over temperature delta T [+0.25] at 3% below calculated reactor trip setpoint [+0.25], 2 of 3 channels [+0.25].

4. intermediate range [+0.25] over power current equivalent of 20% reactor power [+0.25], 1 of 2 channels [+0.25]

   (Exact setpoints required.)

REFERENCE

1. North Anna: Instructor Guide, NCROOP 93.5, p. 2.48.

   001000K407 ..(KA's)

QUESTION 6.03 (2.50)

Unit 1 is at 75% power, cycle 2, 450 ppm boron concentration. CVCS is lined up with a 60 gpm orifice on line, 1B centrifugal charging pump in operation, and control systems in automatic. All other control systems are in automatic.

Pressurizer level channel 459 (controlling channel) then fails to 0%. Several minutes later you notice rods stepping out and Tave dropping rapidly. After rods stop, Tave continues to drop.

Assume no reactor trip and no operator action. EXPLAIN WHY Tave is dropping. INCLUDE any initiating signals and interlocks. (2.5)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.03 (2.50)

The level channel failing low caused orifice isolation valves to close at 15% level [+0.5]. This level signal also causes charging flow to increase, beyond the capacity of the makeup system in this mode [+0.5]. At 5% VCT level on both channels [+0.5], RWST suction valves open and VCT suction valves close [+0.5] causing boration of the RCS from the RWST [+0.5].

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.3, Chemical Volume and Control System, Section II, Learning Objectives C, D, and E.

004000A206 ..(KA's)

QUESTION 6.04 (2.00)

RCS pressure is normally controlled by use of pressurizer heaters and pressurizer spray flow.

a. WHAT normally provides the driving force for pressurizer spray flow? (0.5)

b. Technical Specifications places certain thermal limits on the pressurizer spray flow. WHAT are these limits and WHY are they in place. SPECIFIC values not required. (1.5)

ANSWER 6.04 (2.00)

a. Principle driving force for the spray flow is the delta-P between the RCP discharge and the pressurizer. (Delta-P across the core.) [+0.5]

b. Technical Specifications limits the difference between Tcold (or outlet of Regen heat exchanger) [+0.5] and przr temp [+0.5] to prevent thermal shock of the spray nozzle [+0.5]

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide NCRODP 88.1, Reactor Coolant System, Section II, Learning Objective F.

010000K103 ..(KA's)

QUESTION 6.05 (1.25)

Concerning the reactor coolant pump system and its affect on the Reactor Protection System:

There are four types of trips associated with the reactor coolant pumps protecting the core against departure from nucleate boiling (DNB). One of these is "under frequency".

EXPLAIN the Bases (purpose) of having an underfrequency trip and EXPLAIN WHEN it occurs. INCLUDE any associated coincidence, setpoint or interlock, in your answer. (1.25)

ANSWER 6.05 (1.25)

The underfrequency trip provides reactor protection following a major network frequency disturbance (loss of bus) [+0.25] by tripping the RCP breakers; a minimum coastdown time is ensured [+0.5].

All RCP breakers trip and reactor trips if an underfrequency condition below 56.1 Hz [+0.25] exists on 2 of 3 RCP buses [+0.25].

REFERENCE

1. North Anna: Instructor Guide NCRODP-93.10, Section 1, Learning Objective B.

003000K304 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.06 (1.00)

WHICH ONE (1) of the following correctly completes the sentence: "An undercompensated ion chamber compensates out ....."? (1.0)

(a.) more neutrons and gives a lower signal than anticipated.

(b.) less neutrons and gives a higher signal than anticipated.

(c.) less gamma radiation and gives a higher signal than anticipated.

(d.) more gamma radiation and gives a lower signal than anticipated.

ANSWER 6.06 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 93.2, H 2.7.

015000K601 015000K602 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.07 (1.00)

As reactor thermal power is increased the rod insertion limits (RILs) are required to be progressively higher. The rod bank low low alarm is determined from power level derived from WHICH ONE (1) of the following? (1.0)

(a.) auctioneered high Tave

(b.) auctioneered high Tref

(c.) auctioneered high NI power level

(d.) auctioneered high delta t

ANSWER 6.07 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: NCRODP 93.5, p. 3.8.

2. North Anna: Precautions, Limitations and Setpoints for Nuclear Steam Supply Systems, p. 2.

014000A103 ..(KA's)

QUESTION 6.08 (1.00)

WHAT is the Technical Specification basis for the use of NaOH as an additive to the containment spray system? (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.08 (1.00)

NaOH assures iodine removal efficiency [+0.5] and (because of the increase in pH value) minimizes corrosion effects on components within the containment sump [+0.5].

REFERENCE

1. North Anna: Technical Specification, B 3/4 6-3.
2. North Anna: NCRODP 91.1, p. 3.10.

026020A101 026020K401 000036A202 ..(KA's)

QUESTION 6.09 (2.00)

STATE the FOUR (4) sources of suction to the auxiliary feedwater pump AND their priority of use. (2.0)

ANSWER 6.09 (2.00)

1. emergency cond. storage tank
2. condensate storage tank
3. fire protection water main
4. service water system

[+0.25] for content
[+0.25] for order

Maximum [+2.0]

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: NCRODP 89.4, Section 2, pp. 2.6 and 2.7.

2. North Anna: Technical Specifications, LCO 3.7.1.3 and Bases 1-AP-22.7, p. 4 of 6.

3. North Anna: 1-AP-22.7 "Loss of Emergency Condensate Storage Tank" p.4

061000K401 ..(KA's)

QUESTION 6.10 (1.75)

STATE FOUR (4) auto start signals and coincidences that apply to BOTH the motor driven aux feedwater pump and the turbine driven aux feedwater pump. (1.75)

ANSWER 6.10 (1.75)

1. low low SG level (18%) [+0.25] on 2/3 ch in 1/3 SG [+0.25]

2. MFW pumps breakers open [+0.25] (1/2 brkr on 3/3 MFW pump) [+0.25]

3. SI [+0.25] (20 second delay for diesel start and sequencing on of other loads)

4. loss of reserve station service [+0.25] (2/2 UV (57.5%) on 2/2 transfer buses; unit 1 D&F xfer buses, unit 2 E&F xfer buses) [+0.25]

REFERENCE

1. North Anna: NCRODP 89.4, Section 2, pp. 2.11 and 2.18.

061000K401 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.11 (1.00)

WHAT is the basis for the minimum water level requirement in the ECST? (1.0)

ANSWER 6.11 (1.00)

The basis for the minimum water storage in the ECST is to provide adequate feed to the steam generators [+0.25] to maintain the RCS in hot standby conditions for eight hours [+0.25], with concurrent loss of site power [+.25] and a steam release to the atmosphere.[+0.25]

REFERENCE

1. North Anna: NCRODP 89.4, Section 2, pp. 2.6 and 2.7.

2. North Anna: Technical Specifications, LCO 3.7.1.3 and Bases 1-AP-22.7, p. 4 of 6.

061000K401 ..(KA's)

QUESTION 6.12 (3.00)

ANSWER the following questions concerning the reactor vessel level instrumentation system.

a. IDENTIFY the THREE (3) ranges of RVLIS. (1.0)

b. LIST the vessel regions that each monitors. (1.0)

c. STATE the conditions for which each range is valid. (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.12 (3.00)

a. 1. full range [+0.33]
   2. upper range [+0.33]
   3. dynamic range [+0.33]

b. 1. vessel top to bottom [+0.33]
   2. vessel top to hot leg [+0.33]
   3. vessel top to bottom [+0.33]

c. 1. (water level top to bottom) - all RCPs off (collapsed water level) [+0.33]

   2. (vessel level above the horizontal centerplane of the hotleg) w/all RCPs off [+0.33]

   3. (vessel top to bottom) - pressure drop across the reactor core and vessel intervals for any combination of RCPs running (monitors relative void fraction) [+0.33]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 93.19, p. 1.7.

002000K107 002000K603 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.13 (2.00)

Unit 2 steam generator leak rates at 1600 HR and 2000 HR were determined to be as follows:

	1600	2000
SGA	30 gpd	83 gpd
SGB	49 gpd	49 gpd
SGC	95 gpd	119 gpd

Unit 2 is at 90% rated thermal power.

According to Technical Specifications,

a. WHAT LCO has been entered? (0.5)

b. WHAT are the basis for steam generator tube leak limits? (1.0)

ANSWER 6.13 (2.00)

a. 1. Steam generator C exceeded 100 gpd. [+0.5]

b. Ensure that in the event of a fatigue induced failure, the leak would be detected in sufficient time to conduct an orderly shutdown prior to catestrophic tube failure. [+1.0]

--OR--

Limit on increasing trend indicating 100 gpd would be exceeded w/in 90 min; assuring power can be reduced prior to the propagation of the crack. [+1.0]

--AND--

One gpm for all steam generators not isolated from the RCS ensures that the dose contributions from tube leakage are a small fraction of Part 100 limits on a SGTR or steamline break. [+0.5]

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Technical Specifications, 3.4.6.2 and 3.5.6.3 and Bases Amendment 95.

002000G005 002000G006 ..(KA's)

QUESTION 6.14 (1.50)

In the event of a loss of coolant accident that gradually depressurizes the RCS, STATE the order in which the THREE (3) emergency core cooling systems (ECCS) will inject into the RCS. (1.5)

ANSWER 6.14 (1.50)

1. HPSI
2. accumulators
3. LHSI

[+0.25] for each system, [+0.25] for priority

REFERENCE

1. North Anna: Instructor Guide, NCRODP 91.1 , p.2.9 and 2.12 H 2.2.4 and H.2.2.5.

006000K602 006000K603 ..(KA's)

QUESTION 6.15 (2.00)

a. WHAT are FOUR (4) sources of hydrogen in containment atmosphere? (1.0)

b. According to 2-EP-1, Loss of Reactor or Secondary Coolant, what is the hydrogen concentration at which the Hydrogen recombiners would NOT be placed into service? WHY? (1.0)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.15 (2.00)

a. 1. zirc water reaction
   2. hydrogen added to RCS during normal operations
   3. radiolytic generation in containment sump
   4. radiolytic generation in the core
   5. corrosion of zinc and aluminum

   Any four (4) [+0.25] each. Maximum [+1.0]

b. >4.0% [+0.5] because hydrogen will burn with a spark at concentrations above this concentration. [+0.5]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 91.2, p. 1.33.

2. North Anna: 1-OP-63.1 p. 3.

3. North Anna: 2-EP-1 p.9.

028000K301 ..(KA's)

QUESTION 6.16 (1.00)

The N-16 radiation monitoring system can be used to calculate the magnitude of a steam generator tube leak. WHICH ONE (1) of the following would cause the confidence level in a calculated Steam Generator tube leak to decrease? (1.0)

(a.) a leak at the "U" tube section

(b.) increased power level

(c.) increased leak rate

(d.) a leak at the tube sheet

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.16 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 89.1, H.1.3, p. 3-5, Section Objective D.

035010K111 ..(KA's)

QUESTION 6.17 (1.00)

WHICH ONE (1) of the following will cause the "A" SG Main Feedwater Regulating Valve to initially OPEN? (1.0)

(a.) Narrow range "A" S/G controlling level transmitter fails high.

(b.) "A" S/G controlling feedwater flow transmitter fails high.

(c.) "A" S/G controlling pressure transmitter fails low.

(d.) "A" S/G controlling steam flow transmitter fails high.

ANSWER 6.17 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide, NCRODP 93.12, Steam Generator Water Level Control and Protection, Learning Objective E.

035010K401 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.18 (3.00)

a. WHAT are the temperature and pressure requirements for the RCS prior to placing RHR in service? (1.0)

b. HOW is the RHR protected from an over pressure condition? (1.0)

c. WHAT is the maximum allowable cooldown rate with the RHR in service? WHAT is the basis for this rate? (1.0)

ANSWER 6.18 (3.00)

a. 418 psig [+0.5]
350 deg F [+0.5]

b. RHR suction relief valves set at 467 psig [+0.5] and inlet valve (MOV 1700/1701) auto closure at 582 psig. [+0.5]

c. 100 deg F /hr [+0.5] based on NDT limits [+0.5]
(50 deg F/hr per 1-OP-14.1)

REFERENCE

1. North Anna: Instructor Guide, NCRODP 88.2.

2. North Anna: Technical Specifications 3.4.9.1

3. North Anna: 1-OP-14.1.

005000A101 005000K401 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.19 (1.00)

North Anna Power Station Technical Specifications require that the over temperature delta T channel function test be accomplished on a monthly basis. The last three dates on which this surveillance was performed are August 10, September 10, and October 8. From the dates listed below, SELECT the latest date on which this surveillance can be accomplished without exceeding the periodicity required by Technical Specifications. Note: August has 31 days; September has 30 days, and October has 31 days. (1.0)

(a.) November 7

(b.) November 8

(c.) November 15

(d.) November 18

ANSWER 6.19 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Technical Specifications, Section 3/4.3.
2. North Anna: Instructor Guide, NCRODP 88.5, Terminal Objectives.

194001A106 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.20 (1.00)

Using Administrative Procedure 16.3 (provided), CLASSIFY the following events as one hour or four hour REQUIRED notifications for the NRC. Consider each event separately.

a. Primary system leakage (unidentified) for the last twelve hours has been verified to be greater than 1.5 gallons per minute. The Shift Supervisor has declared an "Unusual Event." (0.25)

b. An Instrument Control Technician working in the Reactor Protection System racks has accidentally shorted out several terminals. This error resulted in a reactor trip. (0.25)

c. A worker inside containment has fallen and sustained a life threatening injury. The decision has been made to immediately transport him to the Medical College of Virginia Hospital. (0.25)

d. The Control Room has just been informed that a contractor, while digging offsite, has cut the Emergency Notification System telephone line. An operational check of the system shows it to be inoperable. (0.25)

ANSWER 6.20 (1.00)

a. 1 hour (accept Immediate Notification) [+0.25]

b. 4 hour [+0.25]

c. 4 hour [+0.25]

d. 1 hour [+0.25]

REFERENCE

1. North Anna: 10CFR50.72.

2. North Anna: ADM 16.3, p. 4 of 5.

194001A108 194001A105 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.21 (2.00)

A major steam generator tube rupture has occurred. You as the shift supervisor have just classified the event as an alert and have begun calling additional emergency personnel. WHO, by title AND priority, may relieve you as the Station Emergency Manager? (2.0)

ANSWER 6.21 (2.00)

1. station manager
2. asst station manager, (O&M)
3. superintendent operations
4. superintendent technical services

[+0.25] for title, [+0.25] for priority

REFERENCE

1. North Anna: Emergency Plan, Section 5, 5.2.1.1.

194001A116 ..(KA's)

QUESTION 6.22 (1.75)

WHO is responsible for acknowledging and approving or authorizing whole body dose limits:

a. from 750 mRem/quarter to 1250 mRem/quarter? (1.0)

(FOUR PERSONS)

b. from 1250 mRem/quarter to 1750 mRem/quarter? (0.25)

c. from 1750 mRem/quarter to 2250 mRem/quarter? (0.25)

d. from 4750 mRem/quarter to 5000 mRem/quarter? (0.25)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.22 (1.75)

a. individual
individual's supervisor
department head
superintendent HP

[+0.25] each

b. station manager [+0.25]
c. vice president nuclear [+0.25]

d. Cannot be authorized during normal situations. [+0.25]
(Station emergency manager can authorize emergency limits.)

REFERENCE

1. North Anna: Health Physics, Procedure HP-5.1.20.

194001K104 ..(KA's)

QUESTION 6.23 (1.00)

An operator reports to you as shift supervisor that she is 3 months pregnant. Her quarterly dose-to-date is 150 mRem.

Her administrative dose will be set at: (1.0)

(a.) 50 mRem/month not to exceed 500 mRem for the current calendar quarter

(b.) 350 mRem for the remainder of her pregnancy

(c.) 500 mRem additional dose for the remainder of her pregnancy

(d.) 0 mRem and exclusion from the RCA for the remainder of her pregnancy

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

ANSWER 6.23 (1.00)

(b.) [+1.0]

REFERENCE

1. North Anna: Health Physics, Procedure HP-5.1.20.

194001K103 ..(KA's)

QUESTION 6.24 (2.00)

According to Administrative Procedure ADM-14.0 "TAGGING OF SYSTEMS AND COMPONENTS" there are four types of tags used at North Anna Power Station.

a. STATE the type of component or situation which would require the following tag types:

   1. electrical danger (0.5)

   2. mechanical danger (0.5)

   3. special order (0.5)

b. WHO is authorized to hang each type? (0.5)

ANSWER 6.24 (2.00)

a. 1. breakers, fuses, switches or connecting devices [+0.5]

   2. valves, blanks, or other mechanical isolating equipment [+0.5]

   3. denote special operating circumstances that must be met prior to operating tagged equipment [+0.5]

b. operations personnel (under direction of the shift supervisor) [+0.5]

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: ADM-14.0.

194001K102 ..(KA's)

QUESTION 6.25 (1.50)

According to ADM-19.22, "Secondary System Chemistry," there are three action levels upon receipt of an out of normal water chemistry reading.

a. WHAT action(s) must be taken within WHAT time if Action Level 2 is entered? (0.75)

b. WHAT action(s) must be taken within WHAT time if Action Level 3 is entered? (0.75)

ANSWER 6.25 (1.50)

a. Action Level 2 - reduce power [+0.25] to 30% [+0.25] w/in 6 hours [+0.25]

b. Action Level 3 - shutdown the plant [+0.25] w/in 6 hours [+0.25] cleanup by feed and bleed or drain and refill [+0.25]

REFERENCE

1. North Anna: ADM-19.22, Secondary Water Chemistry.

194001A114 ..(KA's)

(***** CATEGORY 6 CONTINUED ON NEXT PAGE *****)

QUESTION 6.26 (1.50)

a. WHAT are FOUR (4) "distinct" hazards, specified by Adm. 20.9, Containment Entry and Exit Under Subatmospheric Conditions, personnel might be exposed to during a containment entry under subatmospheric conditions? (1.0)

b. WHO, by TITLE may approve entry into containment during subatmospheric operation? (0.5)

ANSWER 6.26 (1.50)

a. 1. ionizing radiation [+0.25]
   2. heat stress [+0.25]
   3. differential pressure [+0.25]
   4. oxygen deficiency [+0.25]

b. station manager [+0.25]
   asst. station manager [+0.25]

REFERENCE

1. North Anna: ADM 20.9, Containment Entry and Exit Under Subatmospheric Conditions.

194001K108 194001K113 194001K102 ..(KA's)

(***** END OF CATEGORY 6 *****)
(********** END OF EXAMINATION **********)

QUESTION	VALUE	REFERENCE
4.01	1.00	90001
4.02	1.00	90002
4.03	2.00	90003
4.04	2.00	90004
4.05	1.00	90005
4.06	1.00	90006
4.07	3.00	90007
4.08	1.00	90008
4.09	1.00	90009
4.10	1.00	90017
4.11	1.50	90010
4.12	2.50	90011
4.13	1.00	90012
4.14	1.00	90013
4.15	1.50	90014
4.16	1.50	90015
4.17	1.00	90016

	24.00	
5.01	2.50	90018
5.02	2.00	90019
5.03	1.50	90020
5.04	1.00	90021
5.05	1.00	90022
5.06	1.00	90023
5.07	1.00	90024
5.08	2.50	90025
5.09	3.00	90026
5.10	1.00	90027
5.11	1.50	90029
5.12	1.50	90030
5.13	3.00	90031
5.14	1.50	90032
5.15	2.50	90033
5.16	1.50	90034
5.17	2.00	90035
5.18	2.00	90036
5.19	1.00	90047

	33.00	
6.01	1.50	90028
6.02	3.00	90037
6.03	2.50	90038
6.04	2.00	90039
6.05	1.25	90040
6.06	1.00	90041
6.07	1.00	90042
6.08	1.00	90043
6.09	2.00	90044
6.10	1.75	90045
6.11	1.00	90046
6.12	3.00	90048
6.13	2.00	90049

QUESTION	VALUE	REFERENCE
6.14	1.50	90050
6.15	2.00	90052
6.16	1.00	90053
6.17	1.00	90054
6.18	3.00	90055
6.19	1.00	90051
6.20	1.00	90056
6.21	2.00	90057
6.22	1.75	90058
6.23	1.00	90059
6.24	2.00	90060
6.25	1.50	90061
6.26	1.50	90062

	43.25	

	100.2	

revised Key

Nuclear Regulatory Commission
Operator Licensing
Examination

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Official Use Only category on
date of examination.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION
REGION 2

FACILITY: North Anna 1 & 2

REACTOR TYPE: PWR-WEC3

DATE ADMINSTERED: 89/05/08

INSTRUCTIONS TO CANDIDATE:

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	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	24.94	_____	_____	1. REACTOR PRINCIPLES (7%) THERMODYNAMICS (7%) AND COMPONENTS (11%) (FUNDAMENTALS EXAM)
26.75	26.68	_____	_____	2. EMERGENCY AND ABNORMAL PLANT EVOLUTIONS (27%)
48.50	48.38	_____	_____	3. PLANT SYSTEMS (38%) AND PLANT-WIDE GENERIC RESPONSIBILITIES (10%)
100.2		_____ FINAL GRADE	_____ %	TOTALS

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

_____
Candidate's Signature

QUESTION 1.01 (1.00)

UNIT 1 is operating at 85% power with rods in auto, when the operator borates 100 pcm. Shutdown margin will do WHICH ONE (1) of the following? (1.0)

(a.) increase

(b.) increase until rods move

(c.) decrease

(d.) remain unchanged regardless of rod movement

ANSWER 1.01 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide, NCRODP 86.2, Section 9.

192002K114 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.02 (2.00)

For EACH item in column A MATCH the item in column A with its correct definition from column B. (2.0)

Column A

a. moderator temperature coefficient (MTC)

b. fuel temperature coefficient (FTC)

c. Doppler coefficient

d. power defect

Column B

1. resonance capture in U235 as fuel temperature increases

2. negative reactivity effect when fuel temperature increases

3. increased capture of neutrons in U238 as the fuel temperature increases

4. capture of neutrons in the moderator as core temperature increases

5. increase in reactivity as the moderator temperature decreases

6. increase in reactivity as power is increased

7. a combination of FTC, MTC, and void coefficient with appropriate temperature/power change

8. change in reactivity per percent of moderator voiding

ANSWER 1.02 (2.00)

a. 5 [+0.5]
b. 2 [+0.5]
c. 3 [+0.5]
d. 7 [+0.5]

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide 86.2, Reactor Operating Principles, p. IV, Learning Objectives 1, 2, and 3.

192004K108 192004K102 192004K101 ..(KA's)

QUESTION 1.03 (2.00)

Because of a misaligned valve, a dilution of the RCS has begun. The only indication of this event to the operator is the following source range count indications from the log.

Time --	1200	1300	1400	1500	1600	1700
NI32 --	125	125	162	192	446	833

a. If the cause of the dilution is not found, the reactor could go critical at WHICH ONE (1) of the following times? (1.0)

(1.) 1800 hours
(2.) 1900 hours
(3.) 2000 hours
(4.) 2100 hours

b. If Keff before the unplanned dilution was 0.7, WHICH ONE (1) of the following is Keff at 1600 hours? (1.0)

(1.) 0.75
(2.) 0.87
(3.) 0.92
(4.) 0.96

ANSWER 1.03 (2.00)

a. (1.) [+1.0]
b. (3.) [+1.0]

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide 86.2, Reactor Operating Principles, D and E.
2. North Anna: Operating Procedure 1-OP-1.5, Unit Startup from Hot Standby Condition.

192008K106 ..(KA's)

QUESTION 1.04 (2.00)

The reactor has a stable startup rate (SUR) of 0.7 decades per minute (DPM) at BOL.

a. WHICH ONE (1) of the following describes HOW LONG it will take after passing 100 watts power to reach 5 megawatts? (1.0)

(1.) 2.7 min
(2.) 4.7 min
(3.) 6.7 min
(4.) 8.7 min

b. HOW would the SUR be affected if the same amount of reactivity that resulted in a 0.7 DPM SUR (at BOL) was ADDED at EOL? EXPLAIN. (1.0)

ANSWER 1.04 (2.00)

a. (3.) [+1.0]

b. faster [+0.5]
Beff is smaller (0.005 rather then 0.006 due to Pu239) at EOL [+0.5].

REFERENCE

1. North Anna: Instructors Guide 86.1, Reactor Physics Section IX, Learning Objectives A, C, E, and F.

192003K106 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.05 (2.00)

a. Per Technical Specification 3/4.4.9.1, During normal critical operation, WHAT are the MAXIMUM HEAT-UP and COOL-DOWN RATES for the reactor coolant system with exception of the pressurizer? (1.5)

b. Other than temperature, WHAT other variable can be controlled to limit the stresses seen on the reactor coolant system during heatup and cooldown? (0.5)

ANSWER 1.05 (2.00)

a. MAXIMUM HEAT-UP RATE is 60 DEG F in any one hour period (0.75)
MAXIMUM COOL-DOWN RATE is 100 DEG F in any one hour period (0.75)

b. pressure [+0.5]

REFERENCE

1. North Anna: Technical Specification Section 3/4.4.9.1, Pressure/Temperature Limits.

193010K104 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.06 (1.00)

You are performing a routine shutdown procedure with the pressurizer pressure at 415 psig and you find that you are unable to hold pressure and level in the pressurizer. You suspect a PORV is open but your indicating lights are not working.

WHICH ONE (1) of the following is the expected PORV tailpipe temperature if the PORV were indeed open? (Assume for calculation purposes downstream pressure is atmospheric.) (1.0)

(a.) 651 deg F

(b.) 444 deg F

(c.) 320 deg F

(d.) 212 deg F

ANSWER 1.06 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide 83; Thermodynamics, Fluid Flow, and Heat Transfer; Section IV; Learning Objective D.

193003K125 193004K115 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.07 (1.00)

WHICH ONE (1) of the following is NOT an example of a condition which causes water hammer? (1.0)

(a.) sudden closure of a valve in a system in which there is water flow

(b.) cavitation occurring at a flow orifice in a closed system

(c.) rapid pressurization of an otherwise stable (solid) system

(d.) starting a pump on a partially empty system

ANSWER 1.07 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-83; Thermodynamics, Fluid Flow, and Heat Transfer; Section VIII; Learning Objective J.

193006K104 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.08 (1.00)

The reactor is producing 100% rated thermal power at a core delta T of 42 degrees and a mass flow rate of 100% when a blackout occurs. Natural Circulation is established and core delta T drops to 28 degrees.

If decay heat is estimated to be 2%, Which ONE (1) of the following is the mass flow rate through the core in percent relative to the 100% value? (1.0)

(a.) 1%

(b.) 2%

(c.) 3%

(d.) 4%

ANSWER 1.08 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-86.3, Reactor Energy Removal, Section IV, Learning Objective F.

193007K108 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.09 (1.00)

Subcooling margin can be defined as WHICH ONE (1) of the following? (1.0)

(a.) the margin between actual core exit thermocouple temperature and the temperature at which boiling occurs at a given pressure

(b.) the margin between actual core exit thermocouple temperature and 547 deg F at 2000 psig

(c.) the margin between actual core exit thermocouple temperature and 650 deg F at 2000 psig

(d.) the margin between actual core exit thermocouple temperature and 2200 DEG F, one of the ECCS Design Criteria

ANSWER 1.09 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-83; Thermodynamics, Heat Transfer, and Fluid Flow; Section III; Learning Objective E.

193008K115 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.10 (1.00)

WHICH ONE (1) of the following conditions would cause Departure from Nucleate Boiling Ratio (DNBR) to decrease? (1.0)

(a.) increasing Tavg

(b.) increasing primary pressure

(c.) increasing RCS flow rates

(d.) decreasing local power density

ANSWER 1.10 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide 86.3, Reactor Energy Removal, Section II, Learning Objective C.

193008K105 ..(KA's)

QUESTION 1.11 (1.00)

WHICH ONE (1) of the following actions will INCREASE North Anna's thermodynamic cycle efficiency? (1.0)

(a.) increasing component cooling water flow to the letdown heat exchanger

(b.) lowering condenser vacuum from 29" to 25"

(c.) removing a high pressure FW heater from service

(d.) increasing power from 25% to 100%

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

ANSWER 1.11 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP 83, Section 6, Learning Objective H.

193005K103 ..(KA's)

QUESTION 1.12 (1.00)

WHICH ONE (1) of the following conditions would DECREASE available net positive suction head (NPSH) of a centrifugal charging pump? (1.0)

(a.) During normal CVCS operation, VCT level increases from 20% to 41%.

(b.) During normal CVCS operation, hydrogen pressure in the VCT increases from 17 to 25 psig.

(c.) During normal CVCS operation, the temperature of the tube side of the letdown heat exchanger decreases from 127 deg F to 122 deg F.

(d.) During emergency boration, the filter downstream of the boric acid transfer pump becomes partially clogged from boric acid precipitation.

ANSWER 1.12 (1.00)

(d.) [+1.0]

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide NCRODP-03, Thermodynamics, Fluid Flow, and Heat Transfer, Section VIII, Learning Objective C.

191004K106 ..(KA's)

QUESTION 1.13 (1.00)

WHICH ONE (1) of the following is NOT a symptom associated with cavitation of a centrifugal charging pump? (1.0)

a. increased noise and vibration
b. decreased discharge pressure and flow
c. decreased pump and motor temperature
d. fluctuation of motor current and pump speed

ANSWER 1.13 (1.00)

c. [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-83, Thermodynamics, Fluid, Flow, and heat Transfer, Section VIII, Learning Objective D.

191004K101 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.14 (1.00)

The plant has experienced a loss of coolant accident (LOCA) with degraded safety injection flow. The reactor coolant pumps (RCPs) are manually tripped and the resulting phase separation causes the upper portion of the core to uncover (core is slightly uncovered, ~10%).

WHICH ONE (1) of the following describes excore source range (BF3) neutron level indications following the core uncovering relative to the indications just prior to the core uncovering? (1.0)

(a.) significantly less neutron level indication

(b.) significantly greater neutron level indication

(c.) essentially unchanged neutron level indication

(d.) impossible to estimate with the given core conditions

ANSWER 1.14 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-95.2, Mitigating Core Damage, Learning Objective D, Nonhomogeneous Voiding.

191002K117 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.15 (1.00)

WHICH ONE (1) of the following correctly completes the sentence: "An undercompensated ion chamber compensates out ....."? (1.0)

(a.) more neutrons and gives a lower signal than anticipated.

(b.) less neutrons and gives a higher signal than anticipated.

(c.) less gamma radiation and gives a higher signal than anticipated.

(d.) more gamma radiation and gives a lower signal than anticipated.

ANSWER 1.15 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide 93.2, Excore Nuclear Instrumentation, Section II, Learning Objective D.

191002K118 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.16 (1.50)

a. WHICH ONE (1) of the following types of radiation is primarily measured by the self-reading pocket dosimeter (SRPD)? (1.0)

(1.) gamma

(2.) gamma and neutron

(3.) alpha

(4.) beta

b. WHICH type(s) of radiation is/are primarily measured by the Thermoluminescent Dosimeter (TLD)? (0.5)

ANSWER 1.16 (1.50)

a. (1.) [+1.0]

b. gamma [+0.25]
beta [+0.25]

REFERENCE

1. North Anna: Radiation Protection Plan, Chapter IV, Radiation Protection Training, 4/15/88.
2. North Anna: General Employee Training, 1/1/89.

191002K119 ..(KA's)

QUESTION 1.17 (1.50)

Unit 1 is at 100% when steam pressure transmitter PT 475 (Channel III) fails low. STATE HOW and WHY the steam generator steam flow signal is affected. (1.5)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

ANSWER 1.17 (1.50)

The steam flow signal will decrease (approximately 25%) [+0.5]. PT 475 provides density compensation [+0.5] to generate an accurate steam flow mass flow rate [+0.5].

REFERENCE

1. North Anna: Instructor Guide, NCRODP 93.12, p. 1.7 and H1.10, p. 3, Objective E.

191002K102 ..(KA's)

QUESTION 1.18 (1.00)

Concerning CVCS demineralizers:

HOW is demineralizer resin protected from high temperatures in the CVCS? INCLUDE setpoints. (1.0)

ANSWER 1.18 (1.00)

If temperature of CVCS letdown increases to 136 deg F [+0.5] then the temperature control valve (TCV-1143) diverts or bypasses letdown around the demineralizers [+0.5].

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.3, Chemical Volume and Control System, Learning Objective D.

191007K109 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.19 (1.00)

Operating Procedure 1-OP-5.2, "Reactor Coolant Pump Operation, Precautions and Limitations," Steps 4.1.4 and 4.1.5 limit the number of starts of the reactor coolant pump. WHICH ONE (1) of the following is the basis of these limitations? (1.0)

(a.) to prevent damage to the reactor coolant pump shaft

(b.) to prevent damage to the reactor coolant pump impeller

(c.) to prevent damage to the reactor coolant pump bearings

(d.) to prevent damage to the reactor coolant pump motor windings

ANSWER 1.19 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Operating Procedure 1-OP-5.2, Reactor Coolant Pump Operation, 9/29/88.

191005K106 ..(KA's)

(***** CATEGORY 1 CONTINUED ON NEXT PAGE *****)

QUESTION 1.20 (1.00)

WHICH ONE (1) of the following CORRECTLY completes the sentence:

"In the condensate system, the operating point for two pumps operating in parallel will be at _____ as compared to the operating point when one is operating and the other isolated." (1.0)

(a.) the same flow and the same discharge pressure

(b.) a higher flow rate and the same discharge pressure

(c.) a higher flow rate and an increase in discharge pressure

(d.) the same flow rate and an increase in discharge pressure

ANSWER 1.20 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 83, Section 8, Objective E.

191004K109 ..(KA's)

(***** END OF CATEGORY 1 *****)

QUESTION 2.01 (2.00)

WHAT are FOUR (4) of the six MAJOR FUNCTIONS that will be affected by a loss of instrument air in containment as stated in 1-AP-28, Loss of Instrument Air. Include operating and shutdown conditions. (2.0)

ANSWER 2.01 (2.00)

1. RCS pressure control [+0.5] or
   -Pzr spray valves
   -Pzr PORV's if N2 is lost

2. RCP cooling [+0.5] or
   -stator or thermal barrier cooling

3. Loss of containment cooling [+0.5] or
   -chilled water to CTMT recirculation fans
   -cc to CRDM fans
   -CTMT air recirculation fan and CRDM fan air operated dampers

4. Loss of RCS letdown [+0.5] or
   -normal, RHR to letdown, and excess letdown

5. RCS temperature control [+0.5] or
   -CC to RHR Hx
   -RHR bypass flow
   -RHR Hx outlet

6. Disc pressurization control [+0.5]

ANY ONE (1) minor function in each MAJOR FUNCTION for [+0.5] for that MAJOR FUNCTION

MAXIMUM [+2.0]

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: 1-AP-28, "Equipment and Parameter Consideration for Loss of instrument Air", p. 2-4.

000065K303 ..(KA's)

QUESTION 2.02 (2.00)

Per foldout page for Procedure EP-0, "Reactor Trip or Safety Injection," WHAT is the reactor coolant pump trip criteria? (Include conditions for adverse containment.) (2.0)

ANSWER 2.02 (2.00)

Trip all RCPs if both conditions listed below exist:

1. charging [+0.25]/SI pumps [+0.25] - at least one running [+0.5]

2. RCS subcooling based on core exit thermocouples - less than 25 deg F [+0.5]; 70 deg F for adverse containment [+0.5]

REFERENCE

1. North Anna: Emergency Procedure 1-EP-0, "Reactor Trip or Safety Injection," 1/26/89.

000009K323 000015G003 ..(KA's)

QUESTION 2.03 (1.50)

WHAT TWO (2) types of vibration are monitored for the reactor coolant pumps (RCPs)? INCLUDE RCP trip criteria where applicable. (1.5)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.03 (1.50)

1. seismic vibration [+0.5] / 5 mils [+0.25]
2. proximity vibration [+0.5] / 20 mils [+0.25]

REFERENCE

1. North Anna: Annunciator Response, 1-AR-1.
2. North Anna: Instructors Guide NCRODP-88.1, Reactor Coolant.

000015A123 000015G010 000015A209 ..(KA's)

QUESTION 2.04 (1.00)

Concerning Abnormal Procedure 1-AP-15, Loss of Component Cooling:

WHAT are FIVE (5) control room indications of a loss of component cooling water (excluding fluctuating amps) that are entry conditions for Procedure 1-AP-15? (1.0)

ANSWER 2.04 (1.00)

1. cc surge tank low level alarm
2. cc pump auto trip alarm
3. CCW low flow discharge header alarm
4. CCW low pressure discharge header alarm
5. reactor coolant pump low flow/high temperature
6. excess letdown Hx low flow/high temperature
7. non-regenerative Hx high temperature

Any five (5) [+0.2] each, +1.0 maximum.

REFERENCE

1. North Anna: Abnormal Procedure 1-AP-15, Loss of Component Cooling, 10/25/84.

000026G011 ..(KA's)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.05 (1.00)

Unit 1 has just experienced a loss of condenser vacuum. Per Abnormal Procedure 1-AP-14, "Low Condenser Vacuum," WHICH ONE (1) of the following conditions require a manual turbine trip? (1.0)

(a.) condenser pressure > 6.5" Hg abs

(b.) condenser pressure > 7.5" Hg abs

(c.) condenser pressure > 8.5" Hg abs

(d.) condenser pressure > 9.5" Hg abs

ANSWER 2.05 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Abnormal Procedure 1-AP-14, Low Condenser Vacuum, 5/07/84.

000051A202 ..(KA's)

QUESTION 2.06 (1.75)

Functional Restoration Guide, FRP-C.1, "Inadequate Core Cooling," is entered on two RED PATHS. WHAT are those TWO (2) conditions? INCLUDE setpoints. (1.75)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.06 (1.75)

FRP-C.1 is entered from the following conditions as CSFST:

1. core exit T/Cs [+0.5] > 1200 deg F [+0.25]

2. No RCPs running [+0.5] and core exit T/Cs > 700 deg F [+0.25] and RVILIS full range less than 46% [+0.25]

REFERENCE

1. North Anna: Instructors Guide NCRODP-95.6, Function Restoration Procedure, Section 3, Learning Objective B, p. 3.3.
2. North Anna: Functional Restoration Guide, FRP-C.1, "Response to Inadequate Core Cooling," 2/26/88.

000074G011 ..(KA's)

QUESTION 2.07 (2.50)

a. STATE THREE (3) different conditions that require IMMEDIATE or EMERGENCY BORATION of the RCS per North Anna Technical Specifications. (1.5)

b. WHAT are TWO (2) of THREE (3) sources of borated water that can be used for IMMEDIATE or EMERGENCY BORATION. (1.0)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.07 (2.50)

a. 1. inadequate shutdown margin (SDM)
   2. rods below their insertion limit
   3. failure of more than one shutdown or control rod to insert fully during a shutdown
   4. ATWS
   5. Mode 6, Keff > .95 or boron concentration < 2300 ppm

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

b. BAT [+0.5]
   RWST [+0.5]
   BIT

   Any two (2) [+0.5] each, +1.0 maximum

REFERENCE

1. North Anna: Technical Specifications, Sections 3.1.1.1, 3.1.1.2, 3.1.2.1, 3.1.2.7, 3.1.2.8, 3.1.3.3, 3.1.3.5.
2. North Anna: Functional Response Guide 1-FRP-5.1, "Response to Nuclear Power Generation/ATWS," 4/15/87.

000024K301 000024A202 ..(KA's)

QUESTION 2.08 (1.50)

WHAT are the SIX (6) operator immediate actions for a fire at the North Anna Power Station as per Abnormal Procedure 1-AP-50, "Fire Protection - Operations Response?" (1.5)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.08 (1.50)

1. sound fire alarm (for 10 seconds)
2. announce, using the intercom, "Fire! Fire! Fire! at (give location)!" (PA announcement)
3. repeat announcement
4. sound fire alarm (for 10 seconds)
5. repeat announcement
6. dispatch an (knowledgeable) individual from operations to the scene of the fire (to assist stations loss prevention representative/scene leader in assessing the situation)

[+0.25] each

REFERENCE

1. North Anna: Abnormal Procedure 1-AP-50, Fire Protection - Operations Response, p. 2 of 5, 8/25/85.

000067G010 ..(KA's)

QUESTION 2.09 (2.00)

An operator on his normal rounds notices a large "puddle" of water at the base of the RWST. The water appears to be running in the direction of a storm drain.
Per Abnormal Procedure 1-AP-53, "Accidental, Unplanned or Uncontrolled Radioactive Liquid Release," WHAT immediate action is the operator required to take? (2.0)

ANSWER 2.09 (2.00)

1. stop the release, if possible [+0.5]
2. inform shift supervisor [+0.5]
3. inform Health Physics [+0.5]
4. contain any liquid to prevent liquid from entering an uncontrolled area (storm drain) [+0.5]

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Abnormal Procedure 1-AP-53; Accidental, Unplanned or Uncontrolled Radioactive Liquid Release; 1/5/89.

000059K304 000059G011 ..(KA's)

QUESTION 2.10 (2.00)

In reference to Emergency Procedure EP-3, "Generator Tube Rupture, the first ACTION CATEGORY is to IDENTIFY the Ruptured S/G.

WHAT are the other FIVE (5) MAJOR action categories in EP-3. (2.0)

ANSWER 2.10 (2.00)

1. isolate [+0.4]
2. cooldown (to establish RCS subcooling margin) [+0.4]
3. depressurize (RCS to restore inventory) [+0.4]
4. terminate SI (to stop primary-to-secondary leakage) [+0.4]
5. prepare for cooldown to cold shutdown [+0.4]

REFERENCE

1. North Anna: Instructors Guide NCRODP-95.4, Steam Generator Tube Rupture, Section 11, Objective B.

000038K305 ..(KA's)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.11 (2.00)

Assume Unit 1 has suffered a large steam generator tube rupture in the "C" S/G which results in a reactor trip and SI actuation. In addition to high activity levels in the secondary:

a. WHAT S/G indications prior to the reactor trip will alert the operators that the S/G tube rupture is in the "C" S/G? (1.0)

b. WHY is it important to keep pressure in the S/G below the steam generator atmospheric valve setpoint? (1.0)

ANSWER 2.11 (2.00)

a. 1. Rapidly increasing level in the affected S/G. [+0.5]
2. Steam flow/feedwater flow mismatch. [+0.5]
3. (N16)

b. Atmospheric relief valves provide a direct release path to the environment for the contaminated primary coolant. [+1.0]

REFERENCE

1. North Anna: Emergency Procedure 1-EP-3, "Steam Generator Tube Rupture."
2. North Anna: Instructors Guide, NCRODP-95.4, Section 11, EP-3, "Steam Generator Tube Rupture," Learning Objective B and C.

000038A203 000038K302 ..(KA's)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

QUESTION 2.12 (2.00)

Unit 1 has experienced a very large loss of coolant accident (LOCA) within the containment. RWST level is decreasing rapidly.

a. WHAT is the criteria for transferring to COLD LEG recirculation as per Emergency Operating Procedure ES-1.3, "Transfer to Cold Leg Recirculation?" (0.75)

b. Briefly EXPLAIN the sequence of system lineup changes for transferring to cold leg recirculation. (1.25)

ANSWER 2.12 (2.00)

a. RWST level < 29% [+0.75]

b. 1. LHSI discharge to HHSI suction opens
   2. LHSI recirc to RWST closes
   3. LHSI suctions from sump opens
   4. LHSI suction from RWST closes
   5. HHSI suction from RWST closes

   [+0.25] each

REFERENCE

1. North Anna: Instructors Guide NCRODP-95.4, Section 8, ES-1.3, Transfer to Cold Leg Recirculation, Learning Objective B and D.

000011K315 ..(KA's)

QUESTION 2.13 (2.00)

WHAT are the FOUR (4) immediate actions of 1-FRP-S.1, "Response to Nuclear Power Generation/ATWS?" (2.0)

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.13 (2.00)

1. manually trip reactor
2. manually trip turbine
3. check all AFW pumps running
4. initiate emergency boration

[+0.5] each

REFERENCE

1. North Anna: 1-FRP-S.1, Response to Nuclear Power Generator/ATWS, 4/15/87.

000029K312 ..(KA's)

QUESTION 2.14 (1.00)

Unit 1 and 2 are both operating at 100% power when a breaker fire in Unit 1's switchgear room causes a loss of all electrical power to the coolant makeup system (all charging pumps are lost on Unit 1).

Per Abnormal Procedure 1-AP-49, "Loss of Normal Charging," WHICH ONE (1) of the following is an alternate method to supply RCS makeup to Unit 1? (1.0)

(a.) Diesel fire pump can be cross-tied to supply RCS makeup to Unit 1.

(b.) High head safety injection pumps can be utilized to provide makeup to Unit 1.

(c.) Unit 2 can be cross-tied to supply RCS makeup from its makeup system.

(d.) Accumulators will maintain RCS inventory until alternate power supply can be established to Unit 1 charging pumps.

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

ANSWER 2.14 (1.00)

(c.) [+1.0]

REFERENCE

1. North Anna: Abnormal Procedure 1-AP-49, Loss of Normal Charging, 1/7/89.

000022K302 ..(KA's)

QUESTION 2.15 (1.00)

Foldout page of Emergency Procedure 1-EP-0, "Reactor Trip or Safety Injection," lists criteria for REINITIATION of SI. WHICH ONE (1) of the following states this criteria? (1.0)

(a.) RCS subcooling based on core exit TCs - less than 50 deg F (90 deg F)
--OR--
Przr level - cannot be maintained greater than 15% (50%)

(b.) RCS pressure - cannot be maintained greater than 600 psig (650 psig)
--OR--
RCS temperature - cannot be maintained less than 650 deg F (600 deg F) based on core exit TCs

(c.) RCS subcooling based on core exit TCs - less than 30 deg F (80 deg F)
--OR--
Przr level - cannot be maintained greater than 15% (50%)

(d.) RCS pressure - cannot be maintained greater than 400 psig (500 psig)
--OR--
Przr level - cannot be maintained greater than 20% (50%)

ANSWER 2.15 (1.00)

(c.) [+1.0]

(***** CATEGORY 2 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Emergency Procedure 1-EP-0, Reactor Trip or Safety Injection.

000009K328 000040A101 ..(KA's)

QUESTION 2.16 (1.50)

Unit startup is in progress and the reactor operator is utilizing procedure 1-OP-1.3, "Unit Startup from Cold Shutdown Condition (Mode 5) to Hot Shutdown Condition (Mode 4) < 350 deg F." As required the residual heat removal system (RHR) is in service and a bubble has been established in the pressurizer to maintain RCS pressure. The reactor operator has just experienced a failure of wide range RCS pressure transmitter, PT 402, which failed high. As he is calling I&C personnel, he receives annunciator "RHR System Low Flow."

Briefly EXPLAIN the reason for this annunciator. INCLUDE any setpoints, interlocks, automatic actions, or coincidences that may be applicable. (1.5)

ANSWER 2.16 (1.50)

MOV 1700 inlet isolation valve automatically closes [+0.5] when PT402 (PT403) indicates > 582 psig [+0.5]. When MOV 1700 closes the flow path for RHR is blocked resulting in "RHR System Low Flow" annunciator. [+0.5] (This prevents overpressurization of RHR when pressure is close to RHR design pressure).

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.2, Residual Heat Removal System, Section I, Learning Objective B.
2. North Anna: Instructors Guide NCRODP-88.2, Residual Heat Removal System, Section II, Learning Objective D.

000025K302 ..(KA's)

(***** END OF CATEGORY 2 *****)

QUESTION 3.01 (1.00)

State the FOUR (4) sources of suction to the auxiliary feedwater pump and their priority of use. (1.0)

ANSWER 3.01 (1.00)

1. emergency cond. storage tank [+0.2]
2. condensate storage tank [+0.2]
3. fire protection water main [+0.2]
4. service water system [+0.2]

[+0.2] for correct priority of use

REFERENCE

1. North Anna: NCRODP 89.4, Section 2 pp. 2.6 and 2.7
2. North Anna: Technical Specifications, LCO 3.7.1.3 and Bases
3. North Anna: 1-AP-22.7, "Loss of Emergency Condensate Storage Tank" p.4

061000K401 ..(KA's)

QUESTION 3.02 (3.00)

ANSWER the following questions concerning the reactor vessel level instrumentation system.

a. IDENTIFY the THREE (3) ranges of RVLIS. (1.0)

b. LIST the vessel regions that each monitors. (1.0)

c. STATE the conditions for which each range is valid. (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.02 (3.00)

a. 1. full range [+0.33]
   2. upper range [+0.33]
   3. dynamic range [+0.33]

b. 1. vessel top to bottom [+0.33]
   2. vessel top to hot leg [+0.33]
   3. vessel top to bottom [+0.33]

c. 1. (water level top to bottom) - all RCPs off (collapsed water level) [+0.33]

   2. (vessel level above the horizontal centerplane of the hotleg) w/all RCPs off [+0.33]

   3. (vessel top to bottom) - pressure drop across the reactor core and vessel intervals for any combination of RCPs running (monitors relative void fraction) [+0.33]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 93.19, p. 1.7.

002000K107 002000K603 ..(KA's)

QUESTION 3.03 (2.00)

Engineered Safety System (ESF) or Safety Injection (SI) is actuated automatically by four independent signals. WHAT are the FOUR (4) signals and their associated setpoints. (2.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.03 (2.00)

1. low pressurizer pressure [+0.25] at 1765 psig [+0.25]

2. high containment pressure [+0.25] at 17 psia [+0.25]

3. steam line differential pressure [+0.25] 100 psid [+0.25]

4. high steam line flow with Tavg less than 543 deg F (lo-lo Tavg) [+0.25] or steam line pressure less than 600 psig [+0.25]

REFERENCE

1. North Anna: Instructors Guide NCRODP-91.1, Engineered Safety.

013000K101 ..(KA's)

QUESTION 3.04 (1.50)

DESCRIBE the electrical power distribution system for the Rod Drive Mechanisms. INCLUDE power supplies and voltages in your discussion, SPECIFY whether the power is "vital" or "non-vital" power, and INCLUDE all major components between the bus and the REACTOR TRIP BREAKERS. Switchboard identification numbers are not required. (1.5)

ANSWER 3.04 (1.50)

power is supplied by 2 non-vital buses [+0.5]
each bus supplies 3 phase, 480 VAC [+0.5] power to two identical motor generator (MG) sets [+0.5]

REFERENCE

1. North Anna: Instructor Guide NCRODP-93.5, Rod Control and Rod Position Indication System, Section 2, Learning Objective A.

001000K201 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.05 (2.50)

Unit 1 is at 75% power, cycle 2, 450 ppm boron concentration. CVCS is lined up with a 60 gpm orifice on line, 1B centrifugal charging pump in operation, and control systems in automatic. All other control systems are in automatic.

Pressurizer level channel 459 (controlling channel) then fails to 0%. Several minutes later you notice rods stepping out and Tave dropping rapidly. After rods stop, Tave continues to drop.

Assume no reactor trip and no operator action. EXPLAIN WHY Tave is dropping. INCLUDE any initiating signals and interlocks. (2.5)

ANSWER 3.05 (2.50)

The level channel failing low caused orifice isolation valves to close at 15% level [+0.5]. This level signal also causes charging flow to increase, beyond the capacity of the makeup system in this mode [+0.5]. At 5% VCT level on both channels [+0.5], RWST suction valves open and VCT suction valves close [+0.5] causing boration of the RCS from the RWST [+0.5].

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.3, Chemical Volume and Control System, Section II, Learning Objectives C, D, and E.

004000A202 ..(KA's)

QUESTION 3.06 (1.00)

Step 4.2 3 of 1-OP-58.2, "Full Length Rod Control System Operation," has the operator place the bank selector switch in the "Manual" position rather than in the "Individual Control Bank" position when withdrawing rods for startup. WHAT is the reason for this precautionary note? (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.06 (1.00)

The automatic overlap function is disabled when the selector switch is in the "Individual Control Bank" position. [+1.0]

REFERENCE

1. North Anna: 1-OP-58.2, Full Length Rod Control System Operation, 2/19/88.
2. North Anna: Precautions, Limitations, and Setpoints Document.

001000K402 ..(KA's)

QUESTION 3.07 (1.50)

Given the following data concerning the power range nuclear instruments:

	N41	N42	N43	N44
upper actual reading	52 mA	56 mA	58 mA	57 mA
upper 100% current	104 mA	112 mA	112 mA	108 mA
lower actual reading	53 mA	55 mA	56 mA	54 mA
lower 100% current	106 mA	110 mA	112 mA	108 mA

WHAT is the quadrant power tilt ratio (QPTR)? SHOW all work on the attached 1-PT-23 data sheet 1. (1.5)

ANSWER 3.07 (1.50)

corrected currents	N41	N42	N43	N44	Avg
upper	0.5	0.5	0.518	0.528	0.511
lower	0.5	0.5	0.5	0.5	0.5

max upper/tilt = 1.03 max lower/tilt = 1.0
QPTR = 1.03

[+0.75] for corrected currents and average current
[+0.75] for QPTR determination

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Periodic Test, 1-PT-23, Quadrant Power Tilt Ratio, 10/20/88.

015000A104 ..(KA's)

QUESTION 3.08 (1.00)

Which ONE (1) of the following separate events will cause the steam generator "A" MAIN FEEDWATER REGULATOR VALVE to travel in the OPEN DIRECTION? (1.0)

(a.) narrow range "A" S/G controlling level transmitter fails high

(b.) "A" S/G controlling feedwater flow transmitter fails high

(c.) "A" S/G controlling pressure transmitter fails low

(d.) "A" S/G controlling steam flow transmitter fails high

ANSWER 3.08 (1.00)

(d.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-93.12, Steam Generator Water Level Control and Protection, Learning Objective E.

059000K104 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.09 (1.00)

Source range instrument N31 had read 40 cps for the last several hours while in mode 5 at 1250 ppm boron concentration. A welding spike caused N31 to reach 3000 cps for 30 seconds.

WHICH ONE (1) of the following describes plant response? (1.0)

(a.) Suction of the centrifugal charging pumps switches from VCT to RWST.

(b.) CTMT evacuation alarm sounds.

(c.) CTMT purge supply and exaust dampers close.

(d.) An automatic reactor trip signal is generated.

ANSWER 3.09 (1.00)

(b.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-93.2, Excore Instrumentation System, Section 2, Learning Objective C, p. 2.9.

015000K604 004000K107 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.10 (2.75)

Concerning the reactor coolant pump system and its affect on the Reactor Protection System:
There are four types of trips associated with the reactor coolant pumps protecting the core against departure from nucleate boiling (DNB). One of these is "under frequency".

a. NAME the other three (3) trips. (1.5)

b. EXPLAIN the Bases (purpose) of having an underfrequency trip and EXPLAIN WHEN it occurs. INCLUDE any associated coincidence, setpoint or interlock, in your answer. (1.25)

ANSWER 3.10 (2.75)

a. 1. undervoltage [+0.5]
   2. low flow [+0.5]
   3. RCP breaker open [+0.5]

b. The underfrequency trip provides reactor protection following a major network frequency disturbance (loss of bus) [+0.25] by tripping the RCP breakers; a minimum coastdown time is ensured [+0.5].

   All RCP breakers trip and reactor trips if an underfrequency condition below 56.1 Hz [+0.25] exists on 2 of 3 RCP buses [+0.25].

REFERENCE

1. North Anna: Instructor Guide NCRODP-93.10, Section 1, Learning Objective B.

003000K304 ..(KA's)

QUESTION 3.11 (2.00)

WHAT are the Three (3) radiation monitors within the containment that provide automatic control functions? INCLUDE the automatic actions that occur for each. (2.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.11 (2.00)

1. containment gaseous (RM 159) [+0.5] and particulate monitor (RM 160) [+0.5]

2. manipulator crane monitor (RM 162) [+0.5]

   During mode 5 and 6, a "hi-hi radiation alarm" on either monitor [+0.25] results in an automatic closure of the containment purge supply and exaust valves and the fans will trip. [+0.25]

REFERENCE

1. North Anna: Abnormal Procedure 1-AR-5.1, Radiation Monitoring System, 12/22/88.

072000K401 ..(KA's)

QUESTION 3.12 (1.50)

Concerning the steam dump system:

a. WHAT are the TWO (2) modes of operation of the steam dump system? INCLUDE the controlling variables in each mode. (1.0)

b. WHAT TWO (2) inputs give the "steam dump permissive" and makeup the "C-9" interlock? INCLUDE coincidence and setpoints where applicable. (0.5)

ANSWER 3.12 (1.50)

a. 1. steam pressure mode [+0.25] -- utilizes signal from PT-464 [+0.25]
   2. Tavg mode [+0.25] -- utilizes auctioneered hi Tavg [+0.25]

b. 1. 2/2 condenser vacuum > 26" Hg [+0.25]
   2. 2/4 circulating water pumps running (breaker closed) [+0.25]

(***** CATEGORY 3 . TINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide NCRODP-93.11, Steam Dumps, Learning Objectives C and D.

041020K106 ..(KA's)

QUESTION 3.13 (1.25)

Upon trip of the main turbine on Unit 1, the reactor protection system will trip the reactor. WHAT TWO (2) signals are sent to the reactor protection system to indicate the turbine trip has occurred? INCLUDE setpoints and coincidence where applicable. (1.25)

ANSWER 3.13 (1.25)

1. 2/3 [+0.25] auto stop oil (ASO) pressure [+0.25] < 45 psig [+0.25] (from 63-4, 5, & 6)

2. 4/4 [+0.25] throttle valves close [+0.25]

REFERENCE

1. North Anna: Instructors Guide NCRODP-89.5, EHC/Turbine Control and Protection, Learning Objective F.

045010K111 ..(KA's)

QUESTION 3.14 (1.00)

During periods when the temperature of the reactor coolant system (RCS) is low, WHAT major components provide protection against exceeding the nil-ductility (NDT) limits of the RCS? (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.14 (1.00)

RHR relief valves [+0.5]
Pzr PORVs [+0.5]

REFERENCE

1. North Anna: Instructor Guide, NCRODP 88.1, Reactor Coolant System, Section 6, Learning Objective F.

005000K401 ..(KA's)

QUESTION 3.15 (1.00)

Concerning the residual heat removal system (RHR):
DESCRIBE HOW the RCS pressure is maintained during solid plant operation while cooling is being provided by the RHR system. (1.0)

ANSWER 3.15 (1.00)

Pressure is then controlled by the position of PCV 1145 [+1.0].

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.2, Residual Heat Removal System, Learning Objective C.

005000K104 ..(KA's)

QUESTION 3.16 (1.50)

a. EXPLAIN HOW leakage of reactor coolant between the vessel head and the vessel flange is detected. (0.5)

b. HOW can it be determined if the leakage is past the inner or the outer O-ring? (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.16 (1.50)

a. elevated temperature in the leakoff line [+0.5]

b. If leakage is past inner O-ring, shutting the inner leakoff connection isolation valve will cause the temperature in the leakoff line to decrease [+0.5]. If the leakage is past the outer O-ring, the temperature will remain elevated [+0.5].

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.1, Reactor Coolant System, Learning Objective C.

002000K405 ..(KA's)

QUESTION 3.17 (1.00)

MATCH the components in Column A to the pressure in Column B at which injection into the RCS will occur. (1.0)

Column A	Column B
a. accumulators	1. 2650 psig
b. low head injection pumps (LHSI)	2. 2520 psig
	3. 2290 psig
	4. 1560 psig
	5. 1160 psig
	6. 650 psig
	7. 200 psig
	8. 170 psig

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.17 (1.00)

a. 6. [+0.5]
b. 8. [+0.5]

REFERENCE

1. North Anna: Instructors Guide NCRODP-91.1, Engineered Safety Features, Learning Objective B.

006000K602 006000K603 ..(KA's)

QUESTION 3.18 (1.50)

WHICH portions of the Reactor Coolant Pump (RCP) are affected by a "Phase B" containment isolation? (1.5)

ANSWER 3.18 (1.50)

1. motor bearings [+0.5]
2. motor windings [+0.5]
3. thermal barrier heat exchanger [+0.5]

REFERENCE

1. North Anna: Instructors Guide NCRODP-91.1, Engineered Safety Features, Section II, Learning Objective F.
2. North Anna: Instructors Guide NCRODP-92.6, Component Cooling Water, Section I, Learning Objective G.

008000K301 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.19 (1.00)

WHICH one (1) of the following separate events will cause Channel II OT delta T setpoint to decrease?
Assume initially at 100% power, all control systems in automatic except for rods in manual. (1.0)

(a.) Auctioneered high Tavg unit fails high.

(b.) N42 power range lower detector fails low

(c.) PT-1456 pressurizer pressure fails high

(d.) Reduce power to 50% with normal pressure and temperature.

ANSWER 3.19 (1.00)

(b.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide 93.10, Reactor Protection Systems.
2. North Anna: Abnormal Procedure 1-AP-3.4, 10/26/88.
3. North Anna: Abnormal Procedure 1-AP-4.3, 10/27/88.
4. North Anna: Abnormal Procedure 1-AP-3.3, 5/15/86.

012000K603 ..(KA's)

QUESTION 3.20 (1.50)

WHAT are the SIX (6) different flowpaths of electrical power to the North Anna Nuclear Station switch yard? (1.5)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.20 (1.50)

1. line 576 (Midlothian)
2. line 573 (Morrisville)
3. line 575 (Lady Smith)
4. unit 1 main generator
5. unit 2 main generator
6. 230KV Gordonsville line

[+0.25] each

REFERENCE

1. North Anna: Instructors Guide 90.1, Basic Electrical Distribution System, Learning Objective B.
2. North Anna: Technical Specification, Section 3.8.1.1.

062000K104 ..(KA's)

QUESTION 3.21 (2.00)

RCS pressure is normally controlled by use of pressurizer heaters and pressurizer spray flow.

a. WHAT normally provides the driving force for pressurizer spray flow? (0.75)

b. Technical Specifications places certain thermal limits on the pressurizer spray flow. WHAT are these limits and WHY are they in place. SPECIFIC values not required. (1.25)

ANSWER 3.21 (2.00)

a. Principle driving force for the spray flow is the delta-P between the RCP discharge and the pressurizer (delta P across the core) [+0.75]

b. Technical Specifications limits the difference between Tcold (or outlet of Regen heat exchanger) and przr temp [+0.5] to prevent thermal shock of the spray nozzle [+0.75]

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: Instructors Guide NCRODP 88.1, Reactor Coolant System, Section II, Learning Objective F.

010000K103 ..(KA's)

QUESTION 3.22 (1.00)

Normal pressurizer spray flow is unavailable, WHICH ONE (1) of the following is an alternate means of pressurizer pressure control? (1.0)

(a.) auxiliary spray flow from the centrifugal charging pump

(b.) auxiliary spray flow from the SI pumps

(c.) auxiliary spray flow from the auxiliary spray pump

(d.) auxiliary spray from natural circulation cooling

ANSWER 3.22 (1.00)

(a.) [+1.0]

REFERENCE

1. North Anna: Instructors Guide NCRODP-88.1, Reactor Coolant System, Section II, Learning Objective C.

006000K104 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.23 (2.00)

Programmed pressurizer level varies with reactor power. Maintaining the actual level in the pressurizer within this programmed band ensures acceptable plant response under a variety of events. STATE FOUR (4) of the events that are mitigated without adverse affect by maintaining proper pressurizer level. (2.0)

ANSWER 3.23 (2.00)

Design criteria of the pressurizer specifies the pressurizer will allow for the following events without adverse affects:

1. Level will be proper to allow accommodating RCS volume changes caused by the maneuvering of the unit at 5%/min between 15% and 100% power.

2. Liquid level will be sufficient to prevent the heaters from uncovering during a step load increase of 10%.

3. Vapor space will be large enough to accommodate the insurge from 50% loss of load with auto rods and steam dumps without getting a high level trip.

4. Vapor space will be large enough to prevent water relief following a loss of load with the Rx tripping from Pzr high level.

5. Liquid volume will be high enough to prevent emptying on a Rx and turbine trip.

6. A low pressure safety injection is not actuated on a reactor/turbine trip.

Any four (4) [+0.5] each, +2.0 maximum.

REFERENCE

1. North Anna: Instructors Guide NCRODP-93.8, Pressurizer Level and Pressure Control, Learning Objective A.

002000K508 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.24 (3.00)

ANSWER the following questions regarding the containment spray system.

a. WHAT TWO (2) signals will actuate containment spray? INCLUDE coincidence and setpoints. (2.0)

b. WHAT are TWO (2) reasons why sodium hydroxide (NaOH) is added to the containment spray system? (1.0)

ANSWER 3.24 (3.00)

a. 1. hi-hi containment pressure [+0.50] 2/4[+0.25] at 27.75 psia [+0.25]

2. manually pushing 2/2 [+0.5] containment spray actuation pushbuttons simultaneously [+0.5]

b. (to maintain ph > 8.8 in the containment sump after RWST has been emptied) for corrosion control [+0.5] to promote iodine hydrolysis to non-volatile forms in post-accident conditions [+0.5]

REFERENCE

1. North Anna: Technical Specifications 3/4.6.2.1 and 3/4.6.2.3.
2. North Anna: Instructors Guide NCRODP-91.1, Engineered Safety Features, Section III, Learning Objectives A and B.

026000G012 026000K402 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.25 (1.50)

FILL in the North Anna Administrative exposure limits (mRem) for a "Radiation Worker" in the blank spaces in the table provided. ASSUME no exposure extensions have been issued.

		Quarterly Limit	
a.	whole body	_____	(0.5)
b.	skin	_____	(0.5)
c.	extremities	_____	(0.5)

ANSWER 3.25 (1.50)

a. 750 mRem [+0.5]

b. 5000 mRem [+0.5]

c. 15,000 mRem [+0.5]

REFERENCE

1. North Anna: Health Physics Procedure, HP-5.120.
2. North Anna: Administrative Dose Control, 12/22/88.

194001K103 ..(KA's)

QUESTION 3.26 (1.00)

DESCRIBE the process used by the operator to manually stroke EACH of the following valves to properly verify valve position.

a. valves to be verified OPEN (0.25)

b. valves to be verified CLOSED (0.25)

c. LOCKED VALVE in the OPEN POSITION (0.25)

d. THROTTLED valve (0.25)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.26 (1.00)

a. close partially and reopen [+0.25]
b. attempt to close and leave closed [+0.25]
c. no movement necessary [+0.25]
d. Count the turns required to fully close the valve, then reopen the valve to the required position.

REFERENCE

1. North Anna: ADM 19.17, Independent Verification, 12/9/88.

194001K101 ..(KA's)

QUESTION 3.27 (1.50)

An operator entering a CONFINED SPACE may be subjected to hazardous conditions. WHAT are THREE (3) conditions which must be met to allow unattended entry into a confined space? (1.5)

ANSWER 3.27 (1.50)

1. oxygen content within acceptable range (19.5 - 23%)

2. Lower explosive or flammable limit is less than 10%.

3. Level of any substance found in (subpart 2 of) 29CFR (part 1910) is less than permissible explosive limit.

4. Confined space has demonstrated to the qualified person a low potential for development of a hazardous atmosphere or engulfment.

5. IDLH condition does not exist. (immediately dangerous to life and health)

6. Confined Space Entry Permit

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

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

REFERENCE

1. North Anna: ADM 20.10, Confined Area Entry Procedure, 6/23/88.

194001K114 ..(KA's)

QUESTION 3.28 (2.00)

"Access Control" is one of the entry requirements/ conditions for radiological control areas (RCA). WHAT are FOUR (4) others? (2.0)

ANSWER 3.28 (2.00)

1. radiation protection training current
2. radiation work permit
3. dosimetry
4. protective clothing
5. materials brought into the RCA shall be minimized
6. no treated or open wounds

Any four (4) [+0.5] each, +2.0 maximum.

REFERENCE

1. North Anna: Health Physics Procedure HP-8.0.60, Radiological Posting and Access Control, 7/28/88.
2. North Anna: General Employee Training, 1/1/89.

194001K104 ..(KA's)

QUESTION 3.29 (1.00)

Where work area radiation levels are expected to be high (greater than 100 mR/hr) such that a worker can rapidly receive his allowable radiation dose, the worker's occupancy in the work area should be limited on the basis of WHAT TWO (2) predetermined conditions? (1.0)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.29 (1.00)

a. stay time [+0.5]

b. readings on self-reading dosimeters (SDR) or alarming dosimeters [+0.5]

REFERENCE

1. North Anna: Radiation Protection Plan, Chapter V, Section 4, 11/10/88.
2. North Anna: General Employee Training, 1/1/89.

194001K104 ..(KA's)

QUESTION 3.30 (1.00)

WHAT are FOUR (4) "distinct" hazards specified by ADM 20.9, "Containment Entry and Exit Under Subatmospheric Conditions"? (1.0)

ANSWER 3.30 (1.00)

1. ionizing radiation [+0.25]
2. heat stress [+0.25]
3. differential pressure [+0.25]
4. oxygen deficiency [+0.25]

REFERENCE

1. North Anna: ADM 20.9, Containment Entry and Exit Under Subatmospheric Conditions.

194001K108 ..(KA's)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

QUESTION 3.31 (1.00)

A "Normally Closed" safeguards MOV was "Manually Closed" to stop excessive leak-through that was present following a tag out. Valve lineups have now been made to return the system to normal. The safeguards MOV, since it was already in its normally closed configuration, was not operated. WHAT needs to be done (if anything) prior to declaring the system operable? (1.0)

ANSWER 3.31 (1.00)

The MOV must be tested per the applicable periodic test prior to being declared operable [+1.0]

REFERENCE

1. North Anna: Standing Order 148, 3/26/87.

194001K101 ..(KA's)

QUESTION 3.32 (1.00)

Administration Procedure, ADM-19.29, "Administrative Padlocking of Equipment," states that certain equipment may require the use of padlocks to control equipment status.

a. WHO are TWO (2) individuals (by title) who may be responsible to assure that the equipment is operated correctly and returned to its required state following operation? (0.5)

b. WHAT steps must be performed when an administratively locked valve is operated? (0.5)

(***** CATEGORY 3 CONTINUED ON NEXT PAGE *****)

ANSWER 3.32 (1.00)

a. shift supervisor[+0.25]/assistant shift supervisor [+0.25]

b. 1. log the operation [+0.25]
   2. double verify the locked status when complete [+0.25]

REFERENCE

1. North Anna: Administrative Procedure, ADM-19.29, Administrative Padlocking of Equipment, 3/10/88.

194001K101 ..(KA's)

(***** END OF CATEGORY 3 *****)
(********** END OF EXAMINATION **********)

QUESTION	VALUE	REFERENCE
1.01	1.00	90004
1.02	2.00	90059
1.03	2.00	90060
1.04	2.00	90061
1.05	2.00	90030
1.06	1.00	90062
1.07	1.00	90063
1.08	1.00	90064
1.09	1.00	90065
1.10	1.00	90066
1.11	1.00	90067
1.12	1.00	90049
1.13	1.00	90050
1.14	1.00	90052
1.15	1.00	90053
1.16	1.50	90054
1.17	1.50	90055
1.18	1.00	90057
1.19	1.00	90058
1.20	1.00	90068

	25.00	
2.01	2.00	90001
2.02	2.00	90009
2.03	1.50	90035
2.04	1.00	90036
2.05	1.00	90037
2.06	1.75	90038
2.07	2.50	90039
2.08	1.50	90040
2.09	2.00	90041
2.10	2.00	90042
2.11	2.00	90043
2.12	2.00	90044
2.13	2.00	90045
2.14	1.00	90046
2.15	1.00	90047
2.16	1.50	90048

	26.75	
3.01	1.00	90003
3.02	3.00	90010
3.03	2.00	90011
3.04	1.50	90012
3.05	2.50	90013
3.06	1.00	90014
3.07	1.50	90015
3.08	1.00	90016
3.09	1.00	90017
3.10	2.75	90018
3.11	2.00	90019
3.12	1.50	90020
3.13	1.25	90021

QUESTION	VALUE	REFERENCE
3.14	1.00	90022
3.15	1.00	90023
3.16	1.50	90024
3.17	1.00	90025
3.18	1.50	90026
3.19	1.00	90027
3.20	1.50	90028
3.21	2.00	90029
3.22	1.00	90031
3.23	2.00	90033
3.24	3.00	90034
3.25	1.50	90002
3.26	1.00	90005
3.27	1.50	90006
3.28	2.00	90007
3.29	1.00	90008
3.30	1.00	90032
3.31	1.00	90051
3.32	1.00	90056

	48.50	

	100.2	