ANO 2 EXAMINATION REPORT
Report Number: 50-368/OL-86-01

Docket No: 50-368 License No.: NPF-6

Licensee: Arkansas Power & Light Company
P.O. Box 551
Little Rock, Arkansas 72203

Examinations administered at Arkansas Nuclear One Unit 2 (ANO 2)

Chief Examiner: S. L. McCrory, Examiner — Date: 1/24/86

Approved by: R. A. Cooley, Section Chief — Date: 1/24/86

Summary

Examinations conducted on December 10, 1985.

Written and oral examinations were administered to six (6) Senior Reactor Operators and ten (10) Reactor Operators. All candidates except one Senior Reactor Operator passed these examinations.

ANO 2 EXAMINATION REPORT
No. 50-386/OL-86-01

Report Details

1. Examination Results

SRO Candidates				RO Candidates			
Total	Pass	Fail	%	Total	Pass	Fail	%
6	5	1	83	10	10	0	100

2. Examiners

S. L. McCrory, Chief Examiner, NRC
J. Pellet, NRC
D. Graves, NRC
J. Whittemore, NRC
R. Cooley, NRC

3. Examination Report

This Examination Report is composed of the sections listed below.

A. Examination Review Comment Resolution

B. Exit Meeting Minutes

C. ANO 2 Examination Key (SRO/RO Questions and Answers)

Performance results for individual candidates are not included in this report because examination reports are placed in NRC's Public Document Room as a matter of course.

A. Examination Review Comment Resolution

In general, editorial comments or changes made during the examination, the examination review, or subsequent grading reviews are not addressed by this resolution section. This section reflects resolution of substantive comments made during the examination review. Attachment 1 contains the facility comments on both the Reactor Operator and Senior Reactor Operator examinations. Comments, with which NRC did not agree, will be specifically addressed in this section. All other comments are incorporated into the master examination key (as requested or with only minor modification) which is provided elsewhere in this report as are all other changes mentioned above but not discussed herein.

COMMENTS

(1) 1.4/ 5.6 **REJECT.** The 1/M value of 0.0129 is based on the actual source strength which is not normally used to develop 1/M plots. Additionally, the proposed method for calculating this value for 1/M cannot be done without first going through the calculations of parts A and B.

(2) 1.6 **REJECT.** This question was taken from the facility developed unit 2 examination bank and is consistent with the original answer. Further, an increase of 40% is not considered slight.

(3) 1.11 **REJECT.** The term "Xe-eq" is defined in part A as "equilibrium Xenon reactivity". Reactivity worth is usually applied to incremental reactivity change such as reactivity per inch for CEA motion and reactivity per ppm for boron concentration changes. Equilibrium reactivity is an integral or total value. Using boron concentration changes over core life to justify most reactivity changes of the other materials in the core is poor. As a core ages several changes are taking place which cause the macroscopic cross-sections for absorption to change. However, the net effect is that the neutron flux density must increase to sustain a constant power generation level as the core ages. As the flux density increases, the reactivity impact of the poisons in the core increases.

(4) 5.8 The additional step proposed goes beyond the scope of what is required for a full credit answer and will not be credited either for or against the candidate.

(5) 7.8 **REJECT.** The minimum operational steam inlet pressure for the turbine driven EFW pump is 60 psi which equates to a steam generator temperature of about 300°F. Unless the RCS becomes decoupled from the steam generators, its temperature would also be about 300°F when steam pressure became too low to operate the EFW pump. If this were the case, the RCS cooldown that was to be avoided originally has already occurred. Finally, whether the EFW pump can be operated or not has no bearing on avoiding cooldown only in controlling cooldown.

(6) 8.1D **REJECT.** If the statement is not true for all cases then it is false.

B. Exit Meeting Summary

At the conclusion of the exam period, examiners met with representatives of the plant staff to discuss the results of the examinations. The following personnel were present for the exit interviews:

First Week

NRC	UTILITY
S. L. McCrory	J. Vandergrift
D. Graves	W. Perks
J. Whittemore	S. Gulick
W. Johnson	L. McClure
	C. Anderson

NRC informed facility staff that all candidates were clear passes on the oral examinations. NRC reported that some candidates had difficulty determining when, during the course of accident recovery, it was possible to secure safety injection. Procedures provided little or no guidance addressing the situation. Generally, all candidates performed well to exceptionally well on the oral examinations.

Second Week

NRC	UTILITY
R. A. Cooley	J. Vandergrift
J. Pellet	W. Perks
C. Harbuck	L. McClure
	A. Elliot
	S. Gulick
	C. Anderson

NRC reported that all candidates were clear pass on the oral examinations and that there were not signficant generic weaknesses observed.

C. ANO 2 Examination Key

Date Administered: December 10, 1985
Exam Type: Reactor Operator and Senior Reactor Operator

U.S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

Facility: ANO Unit 2

Reactor Type: CE-PWR

Date Administered: 12/10/85

Examiner: S.L. McCrory

Candidate: _____

INSTRUCTIONS TO CANDIDATE:

READ THE ATTACHED INSTRUCTION PAGE CAREFULLY. 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	25			1. Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow
25	25			2. Plant Design Including Safety and Emergency Systems
25	25			3. Instruments and Controls
25	25			4. Procedures - Normal, Abnormal, Emergency, and Radiological Control
100				TOTALS

Final Grade _____%

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.
2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.
3. Use black ink or dark pencil only to facilitate legible reproductions.
4. Print your name in the blank provided on the cover sheet of the examination.
5. Fill in the date on the cover sheet of the examination (if necessary).
6. Use only the paper provided for answers.
7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.
8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write on only one side of the paper, and write "Last Page" on the last answer sheet.
9. Number each answer as to category and number, for example, 1.4, 6.3.
10. Skip at least three lines between each answer.
11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.
12. Use abbreviations only if they are commonly used in facility literature.
13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.
14. Show all calcualtions, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.
15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.
16. If parts of the examination are not clear as to intent, ask questions of the examiner only.
17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.
18. When you complete your examination, you shall:
    a. Assemble your examination as follows:
       (1) Exam questions on top.
       (2) Exam aids - figures, tables, etc.
       (3) Answer pages including figures which are a part of the answer.
    b. Turn in your copy of the examination and all pages used to answer the examination questions.
    c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.
    d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.
    e. Do not dicuss the examination with other licensee staff personnel until the formal examination review is complete.

1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW

1.1 Given the conditions below, calculate the time required for reactor vessel bulk water temperature to reach 212°F. STATE ALL ASSUMPTIONS AND SHOW ALL WORK FOR FULL CREDIT. (3.0)

Conditions:

1. The reactor has been shutdown for 100 hours after a 250 day run at 100%.
2. ALL means of removing heat from the vessel are lost.
3. No circulation to the primary loops occurs.
4. Reactor vessel water is initially at 112°F and well mixed.
5. The reactor vessed head is de-tensioned but still sealed.

ANS:

ASSUMPTIONS

A. Vessel water volume = 3000 - 5000 cu. ft. (0.5)
B. Decay heat load = 0.1 - 0.5% rated thermal power (0.5)
C. Rated thermal power = 2750 - 2850 MW (0.5)
D. Water density = 59.8 - 61.8 lbm/cu.ft. (.25)
E. 57,000 Btu/min = 1 MW (.25)
F. 1 Btu will raise 1 lbm water 1°F (.25)

SOLUTION

G. Water Mass = AxD = 209,300 - 309,000 lbm (0.1)
H. Heat Load = BxCxE = 2-15 MW = 1.14 - 8.55×10^5 Btu/min (0.1)
I. Heat Required = FxGx(dT=100°) = 21 - 31×10^6 Btu (0.1)
J. Time Required = I/H = 24 - 272 min = 0.4 - 4.5 hours (.45)

KEY:

HTTRANS

REF:

BASIC CE REACTOR DESIGN, STEAM TABLES, BASIC HT&T

VAL:

as indicated in the answer.

1.2 A. What is the minimum reactivity that must be added to a critical reactor for it to be prompt critical? (1.0)

B. How much (by what factor) would power increase in one second at ANO 2 if it were prompt critical? (2.0)

ANS:

A. p (reactivity) GE beta effective (beta value = 0.005 -0.007)

B. $T = l^*/p + (B-p)/tp$ (0.5)
So for prompt critical neglect the delayed term so that
$T = l^*/p$ (.25)
$l^* = 10^{-4} - 10^{-5}$ sec (.25)
$p = 0.005 - 0.007$ (.25)
$T = .0014 - 0.02$ sec (.25)
$P/P_o = e^{t/T} = e^{(50 - 700)/1 \text{ sec}}$ (0.5)

KEY:

RXTH COREOPS

REF:

BASIC REACTOR THEORY

VAL:

1 pt for A, and as indicated for B.

1.3 A. Explain how neutron production and indicated count rate would change if the neutron sources were removed from the reactor while it was subcritical (K_{eff} less than 1). (2.0)

B. Explain how long it would take to reach a steady-state count rate when K_{eff} is increased from 0.990 to 0.999 if it took one minute to achieve a steady-state count rate when K_{eff} was increased from 0.90 to 0.99. (1.0)

ANS:

A. The count rate would decrease to a small value since the reaction is not self-sustaining (1.0). Neutron production would not go to zero since spontaneous and cosmic fissions still occur, but the indicated count rate could be 0 due to instrument limitations (1.0).

B. Longer (0.7) - 10 minutes OR 10 times as long (0.3).

KEY:

RXTH NEUT

REF:

BASIC REACTOR THEORY

VAL:

As indicated in the answer.

1.4 During a reactor startup, the operator stops regulating group CEAs at 144 steps on group 3. The source range count rate levels off at 1857 cps. The initial count rate was 400 cps at 0 steps withdrawn on regulating group 1, with K_{eff} = 0.940. (1.5)

A. Calculate the 1/M value for this control position.

B. What is the new value of K_{eff} at this condition?

ANS:

A. $1/M = CR_1/CR_2 = 400/1857 = 0.215$
(The candidate may calculate the source term using CR = $S/(1-K_{eff})$ and then calculate 1/M using $1/M = 1-K_{eff}$. This will generate a 1/M = .0129 based on a CR = 24. This is not an operationally meaningful value since K_{eff} must = 0 before the source level could be seen on the instruments. Give credit only if the candidate states that 1/M is based on source level.)

B. $$1/M = \frac{1 - K_{eff_2}}{1 - K_{eff_1}}$$

$1 - K_{eff_2} = (1-0.940) \times 0.215 = 0.9871$

KEY:

COREOPS REAC

REF:

ANO 2 RTTM CH 15

VAL:

0.5 pt for A
1 pt for B

1.5 Explain why a relief valve body-to-bonnet leak will produce superheated steam if it is located on a steam generator but will not if located on the pressurizer. Use the mollier diagram provided and assume approximately normal full power values for pressures.

(2.0)

ANS:

SEE ATTACHED MOLLIER DIAGRAM
Leakage from a valve is an isenthalpic process. Using mollier diagram, assume S/G pressure of 1000 psia and primary of 2200 psia and draw a straight line (constant enthalpy) we find 80°F superheat for 100 psia at 14.7 psia, but not when 14.7 psia is reached for 2200 psia.

KEY:

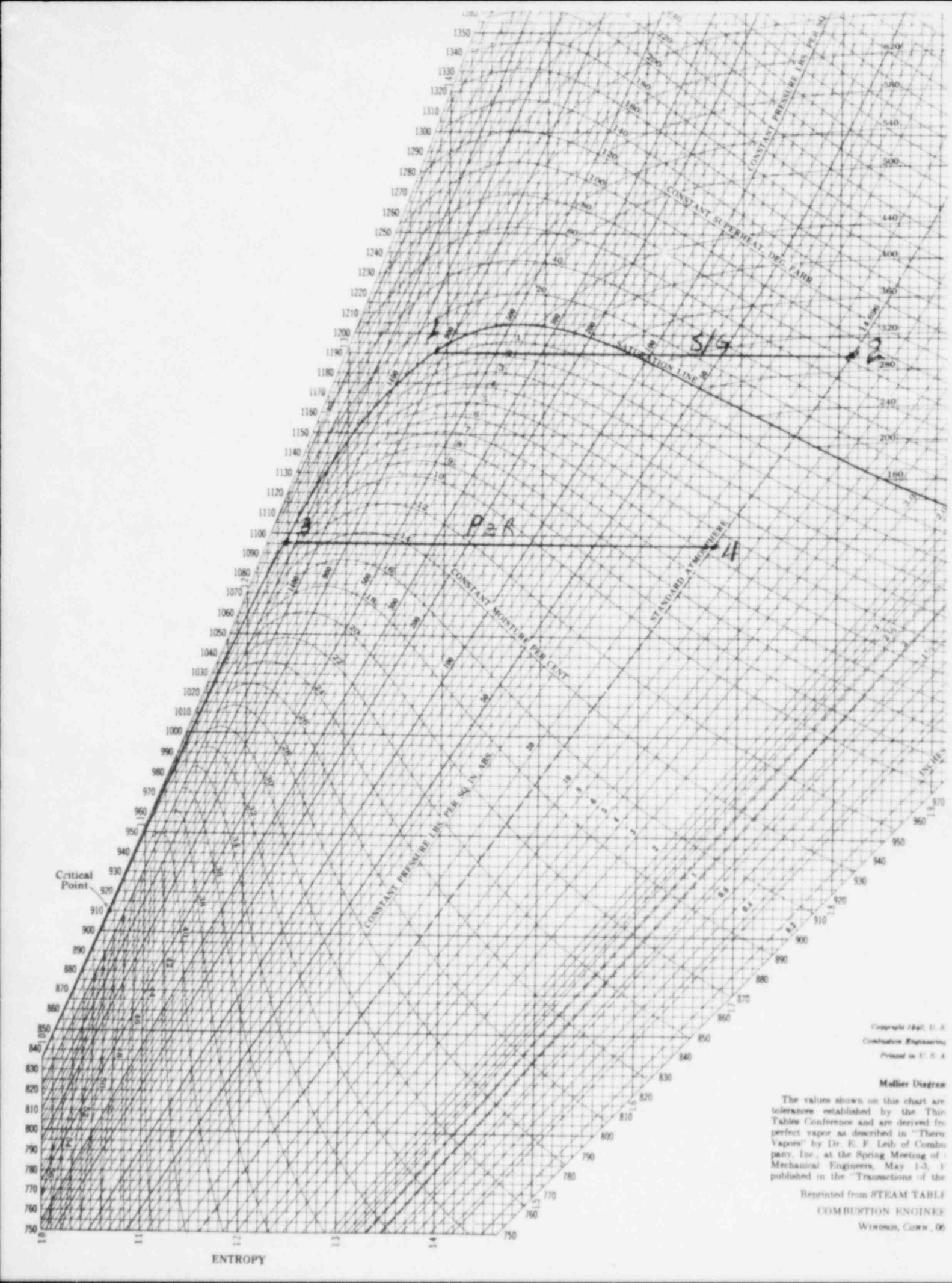
FLUID

REF:

ANO 2 HTFFM CH 2 & 4

VAL:

1 pt ea for use of mollier and explaination



Mollier Diagram

The values shown on this chart are tolerances established by the Thir Tables Conference and are derived fr perfect vapor as described in "Therm Vapors" by Dr. E. F. Leib of Combu pany, Inc., at the Spring Meeting of t Mechanical Engineers, May 1-3, 1 published in the "Transactions of the

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Windsor, Conn., 06

1.6 TRUE or FALSE: (1.5)

A. If the system temperature difference that is driving natural circulation flow is doubled, the heat removal rate will go up by slightly greater than a factor of two.

B. Viscosities of liquids decrease when the temperature increases.

C. If the pressure in a leaking pipe is reduced by 50%, the leak rate should be reduced by approximately 50%.

ANS:

A. FALSE ($dT^{3/2}$ & Q)
B. TRUE
C. FALSE ($flow^2$ & dp)

KEY:

FLUID HTTRANS

REF:

ANO 2 HTFFM CH 5 & 10

VAL:

0.5 ea

1.7 What four basic conditions must exist in order to create continuous flow due to natural circulation? (2.0)

ANS:

1. Heat source
2. Heat sink
3. Flow path (hydraulic coupling)
4. Elevation difference - heat sink above heat source

KEY:

FLUID HTTRANS

REF:

ANO 2 HTFFM CH 9

VAL:

0.5 ea

1.8 Concerning RCP's NPSH, as system temperature is increased, why must system pressure be increased? (1.0)

ANS:

NPSH = P_{sys} - P_{sat}, or absolute pressure minus P_{sat}. As temperature increases, P_{sat} increases, to maintian positive NPSH, pressure must be increased.

KEY:

FLUIDS

REF:

ANO 2 HTFFM CH 6

VAL:

1 pt

1.9 Although the U^{238} resonance capture peaks broaden and flatten with increased fuel temperature, the area under the peak remains the same. Why then is there an increase in neutron capture as the fuel temperature is encreased? (1.0)

ANS:

The neutron population at resonance energy (neutrons capable of being absorbed) increases. This is due to the resonance encompassing a wider energy range (reduction in self shielding).

KEY:

NEUT RXTH REAC

REF:

ANO 2 RTTM CH 17

VAL:

1 pt.

1.10 A. True or False? After a reactor trip, the reactor will reach a stable negative startup rate of about 0.33 dpm (80 sec period). (0.5)

B. How does the change in Beta-effective over core life affect the STABLE reactor period after a reactor trip? (0.5)

C. How does Beta-effective change over core life? (0.5)

D. How does the change in Beta-effective over core life affect the TRANSIENT reactor period after a reactor trip (before reaching a stable period)? (0.5)

ANS:

A. TRUE
B. NONE
C. $Beta_{eff}$ gets smaller
D. Transient period is shorter (due to faster response with a smaller Beta).

KEY:

RXTH COREOPS

REF:

BASIC REACTOR THEORY

VAL:

0.5 each

1.11 A. HOW does equilibrium Xenon reactivity (XE-eq) at hot full power change as a function of core age (EFPD)? (0.5)

B. WHY does Xe-eq change as a function of core age? (1.5)

ANS:

A. Xe-eq gets larger as a function of core age.
B. Xe-eq is a function of flux not power (0.75) and flux increases as a function of core age (0.75).

KEY:

RXTH POISONS

REF:

BASIC REACTOR THEORY

VAL:

As indicated.

1.12 The ratio of Plutonium atoms to U^{235} atoms increases as the core ages. Explain what affect the ratio has on the following: (3.0)

A. Delayed neutron fraction
B. SUR
C. Doppler defect

ANS:

A. Delayed neutron fraction decreases because beta is less for plutonium.
B. SUR would be larger because beta decreased.
C. Doppler defect would increase because of more capture in Pu^{240}.

KEY:

CORE RXTH

REF:

ANO 2 RTTM CH 13

VAL:

3 pts, 1 pt ea

END OF CATEGORY 1

2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS

2.1 A. Descrive the instrumentation available to the operator for monitoring the condition of of the RCP seals. (1.0)

B. What indications would you have if a coolant pump first stage seal failed? (1.0)

ANS:

A. 1. Pressure indication on each of the seal cavities.
2. High control bleed off flow alarm and indication
3. High control bleed off temperature alarm and indication.

B. Mid-stage seal cavity pressure would go to RCS pressure, upper seal cavity pressure would increase proportionally. Potential for C.B.O. to increase flow and temperature.

KEY:

RCS PUMP DESGN IND SEALS

REF:

ANO 2 STM-2-03

VAL:

A. 0.333 ea
B. 0.333 per line

2.2 A. What equipment (5 items) discharges to the Quench Tank?(1.5)

B. What three alarms are associated with the quench tank? (1.0)

C. If the Quench Tank level is too high, where can the operators discharge the excess water? (0.5)

ANS:

A. (ANY FIVE)
1. RCP seal water relief
2. Pressurizer safeties
3. LTOP's
4. ECCS vent
5. Reactor vessel head vent
6. Pressurizer high point vent
7. Nitrogen addition
8. Reactor makeup water addition

B. 1. Level hi/lo
2. Hi pressure
3. Hi temperature

C. Reactor coolant drain tank

KEY:

RCS TANK IND PATH

REF:

ANO 2 STM-2-03, FSAR 5-5

VAL:

A. 0.3 ea
B. 0.333 ea
C. 0.5

2.3 What indication does the operator have that the reactor vessel head inner gasket is leaking? (1.0)

ANS:

Leakage is detected whenever the temperature in the leakoff line reaches GT 150°F and the RCS RV head leakoff alarm sounds (on 2K10, D4).

KEY:

RCS IND SEALS

REF:

ANO 2 STM-2-02

VAL:

0.5 ea for temp and alarm

2.4 What five systems does the RWT provide water for? (1.5)

ANS: (ANY FIVE)
1. Containment spray
2. Lp safety injection
3. Refueling canal fill
4. Fuel pool makeup
5. CVCS makeup (emergency boration)
6. HPSI
7. SITs

NOTE: ECCS may be substituted for any <u>one</u> of HPSI, LPSI, or Containment Spray.

KEY:

MAKEUP TANK PATH

REF:

ANO 2 STM-2-08

VAL:

0.3 ea

2.5 Identify the voltage by its corresponding letter designation. Write the answers on the paper p.ovided for answers. (2.0)

A.	B	1.	6900 VAC
B.	A	2.	4160 VAC
C.	LA	3.	480 VAC
D.	H	4.	120 VAC
E.	D	5.	120 Inst. AC
F.	RA	6.	125 VDC
G.	Y	7.	120 VAC RPS & ESF dist.
H.	RS	8.	125 VDC RPS & ESF dist.

ANS:

A. 3
B. 2
C. 4
D. 1
E. 6
F. 8
G. 5
H. 7

KEY:

ELEDST

REF:

ANO 2 STM-2-32

VAL:

0.25 ea

2.6 Describe the operation of and reason for the "Kirk" key interlock for the 2A310 and 2A410 breakers (2A3 and 2A4 cross-ties). (2.0)

ANS:

Operation - Insert 3 of 4 keys into panel to release 2A3/2A4 cross-tie keys as follows;

1. Key for supply breaker from 2A1
2. Key for supply breaker from 2A2
3. DG1 outupt breaker
4. DG2 output breaker

Reason - Prevent paralleling of power supplies through the cross-ties. (or words to that effect)

KEY:

ELEDST BKR

REF:

ANO 2 STM-2-32

VAL:

A. 0.2 ea for leadin and each step
B. 1 pt

2.7 List by name six valves that are supplied by the electro-hydraulic oil system. (General types of valves, no individual valve numbers). (1.5)

ANS: (ANY SIX)

1. Main feed pump control valves
2. Turbine control valves
3. Turbine stop valves
4. Extraction relay dump valve
5. Main feed pump stop valves
6. Turbine intercept stop valves
7. Turbine intercept valves

KEY:

EHC COMP PATH VALVE

REF:

ANO 2 STM-2-24

VAL:

0.25 ea

2.8 With the plant at 15% power during a plant startup, the operator is maintaining steam generator levels with all FWCS Hand/Auto stations in "manual". (2.0)

A. What will the response of the FWCS be if a reactor trip occurs?

B. What are two problems this could create if there were no operator action to correct?

ANS:

A. Feed water flow will remain constant.

B. 1. Result in overfeeding the S/G
2. Overcool the RCS

KEY:

MFW CNTRL VALVE

REF:

ANO 2 STM-2-69

VAL:

A. 1 pt
B. 0.5 ea

2.9 List the three sources of water for EFW and state when each is used. (3.0)

ANS:

1. S/U and B/D Demin. effluent - low power(LT 10%)/shutdown
2. Condensate storage tanks - normal (GT 10%)
3. Service Water System - Emergency

KEY:

AFW PATH

REF:

ANO 2 STM-2-19

VAL:

0.5 ea

2.10 TRUE or FALSE (2.5)

A. The refueling machine hoist can not be lowered with the bridge in motion (bridge drives energized).

B. The mast bumper interlock is only operable when the bridge is over the core region of the refueling canal.

C. If the spreader is not retracted, bridge motion is prevented.

D. The bridge will not move into the upender area unless the upender is vertical.

E. The "cable slack" interlock will stop hoist down motion.

ANS:

A. TRUE
B. FALSE
C. TRUE
D. TRUE
E. TRUE

KEY:

REFUEL

REF:

ANO 2 STM-2-51

VAL:

0.5 ea

2.11 Explain the purpose of the bypass lines with the pressure control valves in the CCW system. (1.0)

ANS:

Maintain constant preset backpressure in each loop with varying loads on the system.

KEY:

CCW VALVE

REF:

ANO 2 STM-2-43

VAL:

1 pt

2.12 Draw a sketch of the Reactor Coolant System. Include all penetrations, major components, major instrumentation tap, and loose parts monitor detectors. (3.5)

ANS:

SEE ATTACHED FIGURE

The following items are 0.2 pt ea
Reactor
RCP's (0.05 ea)
S/G's (0.1 ea)
Pzr
Spray valves (0.05 ea) and Aux spray (0.1)
RDT drains, sample points (0.022 ea)
SIS/SDC, SDC connections (0.04 ea)
Charging and letdown (0.067 ea)
Pzr code safties (0.1 ea)
Quench tank

RTD's 0.021 ea
- T_h 9 per loop
- T_c 3&3 per loop
- surge line
- relief 2
- quench tank
- pzr interface

Pressure detectors 0.05 ea
- pzr 4
- quench tank

Level detectors 0.083 ea
- pzr 2
- quench tank

Vibration and loose parts monitors 0.083 ea
- SG 1 ea
- Reactor vessel

KEY:

RCS PATH DESGN

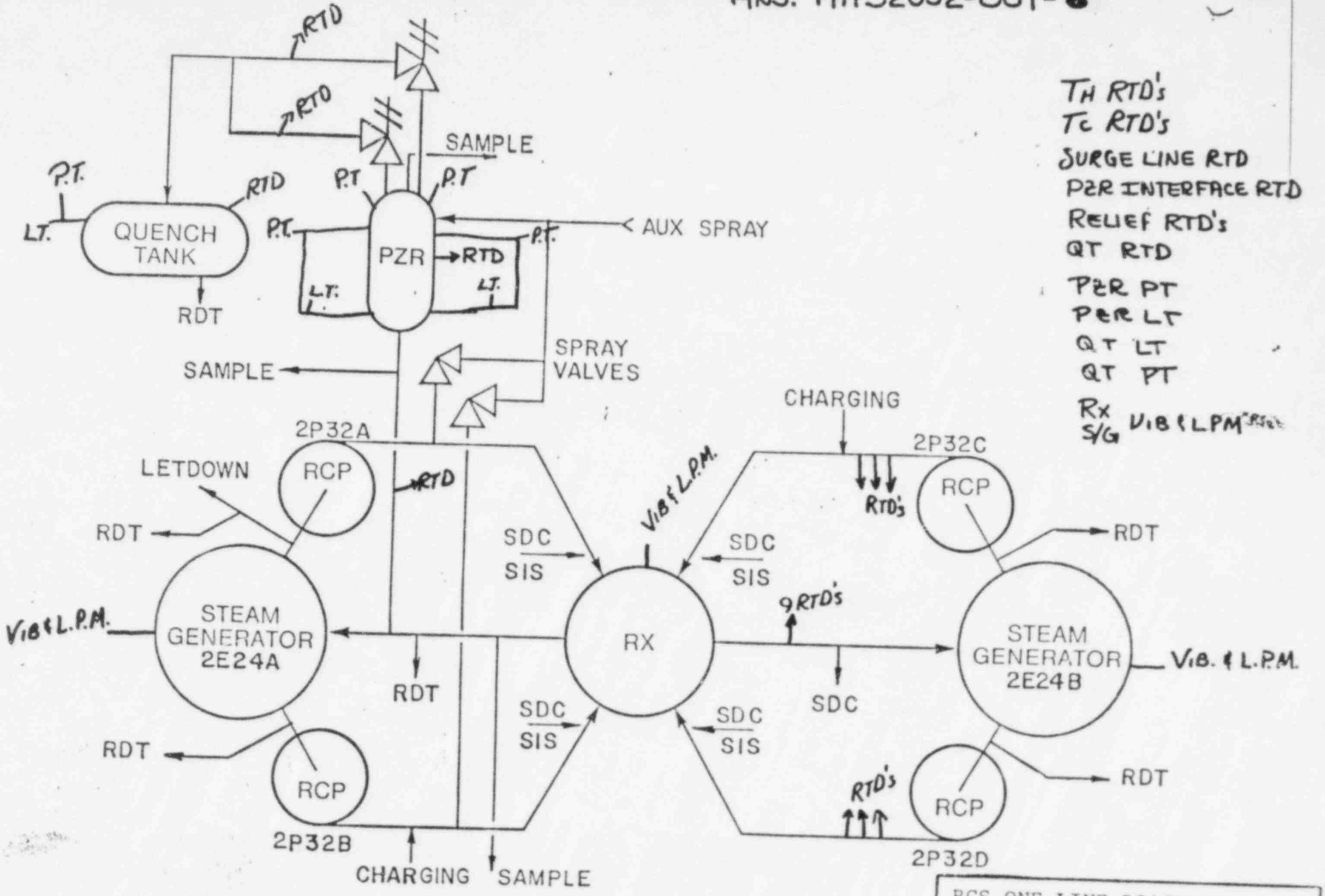
REF:

ANO 2 STM-2-03, P&ID's

VAL:

AS INDICATED

END OF CATEGORY 2



TH RTD's
TC RTD's
SURGE LINE RTD
PZR INTERFACE RTD
RELIEF RTD's
QT RTD
PZR PT
PZR LT
QT LT
QT PT
Rx S/G VIB & LPM

REACTOR COOLANT SYSTEM

FIGL 3.2

RCS ONE-LINE DIAGRAM			
LP TITLE: REACTOR COOLANT SYSTEM			
LP No.	FIG!	DATE	REV
STM-2-3	3.2	6-82	0

3. INSTRUMENTS AND CONTROLS

3.1 List the 12 setpoints with their control/alarm functions associated with the pressurizer level control system. (3.0)

ANS:

13.2%	Hi Hi level alarm
12.5%	Hi Hi level alarm clear
11.1%	Letdown Max.
4.5%	Hi level alarm
	All heaters on
	Backup signal to stop all backup charging pumps
3.8%	All charging pumps off
	Clears signal for all heaters on
	Hi level alarm clears
*0.0%	Level set (Not a control/alarm setpoint)
-1.4%	Letdown to min.
	Stop 1st B/U charging pump
-2.0%	Stop 2nd B/U charging pump
-3.1%	Start 1st charging pump
-4.2%	Clear signal to start all charging pumps
-4.8%	Start 2nd B/U charging pump
-5.2%	B/U signal to start all charging pumps
	Lo level alarm
	Clear lo level alarm
29.0%	Lo-Lo level alarm (actual level)
	Heater cutout

NOTE: Tolerance for setpoint $\pm$ 0.5%

KEY:

PZR CNTRL

REF:

ANO 2 STM-2-03

VAL:

0.1 ea for setpoint
0.15 ea for single functions, where a setpoint has multiple functions, divide 0.15 evenly amoung the number of functions.

3.2 During normal power operation, the two temperature sensing elements on the outlet of the letdown heat exchanger fail high. What control functions occur? (2.0)

ANS:

1. 2TE-4815 fails high - CCW flow controller valve from letdown heat exchanger will go full open (0.5).

2. 2TE-4805 fails high - this will isolate the letdown flow to the CVCS rad-monitors (0.5) and boronometer (0.5) and also bypass letdown flow around the demineralizers to the VCT(0.5). (This feature protects these components from high temperature conditions which they are not designed to handle.)

KEY:

CVCS CNTRL AOP VALVE

REF:

ANO 2 STM-2-4

VAL:

AS INDICATED

3.3 List six of the eight functions for which the 125 VDC Power System is designed to provide power. (2.0)

ANS: (ANY SIX)

1. 6.9 kV switchgear control
2. 4.16 kV switchgear control
3. 480V load control
4. Reactor control (control rod drive, reactor trip circuit breaker control)
5. Reactor instrumentation and protective system
6. Engineered Safeguards System
7. Inverters (vital 120 VAC)
8. Other equipment necessary for normal unit opertion, and normal and emergency shutdown. (any component operated with 125VDC)

KEY:

ELEDST CNTRL

REF:

ANO 2 STM-2-32

VAL:

0.333 ea

3.4 In reference to the SDBCS quick-opening block signals: (1.5)

A. What are the two signals?
B. What valves are affected by each?
C. What is the purpose of the block signals?

ANS:

A. 1. T_{ave} low
2. Reactor tripped

B. 1. Reactor trip blocks 2 upstream and 1 downstream atmospheric dump valves.
2. Low T_{ave} and reactor trip blocks remaining valves

C. Prevents excessive cooling of the RCS

KEY:

MNSTM VALVE CNTRL

REF:

ANO 2 STM-2-23

VAL:

A. 0.25 ea
B. 0.3 ea
C. 0.4

3.5 If a CEA is stuck, what will give the most reliable indication of its position and why? (1.5)

ANS:

The reed switch position indication is the most reliable (0.5) because it uses a magnet on the CEA extension shaft to activate reed switches and show actual position (0.5). The pulse counter position indication only counts the pulses sent to the coils to change rod position and will continue to indicate changing rod position even if the rod is stuck (0.5).

KEY:

RODCNTRL IND

REF:

ANO 2 STM-2-02

VAL:

AS INDICATED

3.6 A. List the three dedicated CPC indications provided in the control room (do not list the digital display or any alarm/status lights). (1.0)

B. List the three dedicated COLSS indications provided in the control room (i.e., items that are permanently displayed vice assigned points normally on display). (1.0)

C. Why is the COLSS system not used for the reactor protection system? (1.0)

D. Which is more accurate COLSS or CPC's? (0.5)

ANS:

A. 1. Margin to DNB
2. Calibrated neutron flux
3. Margin to LPD

B. 1. Core power limit, based on margin to DNB
2. Core power limit, based on margin to LPD
3. Core power

Note: Linear power KW/FT/DNBR limit meter (2J19042/9040) may be substituted for either 1 or 2 but not both.

C. Too slow for indicating actual plant conditions during transients.

D. COLSS

KEY:

RPS IND DESGN

REF:

ANO 2 STM-2-65,66

VAL:

A. 0.333 ea
B. 0.333 ea
C. 0.5 ea for "too slow" and "transients"
D. 0.5

3.7 During full power operation, the CIAS inadvertently actuates.

A. What effect doe this have on continued plant operation and why? (1.5)

B. What is required to reset it? (1.0)

ANS:

A. CIAS actuation affects the operation of the plant by isolating the majority of auxiliary features fed into containment. Due to the requirements of CCW to cool the RCP's and seals (0.5), the plant will be tripped (0.5) and RCP's shutdown on receipt of a high temperature alarm from the RCP or after 5 minutes without CCW OR override CIAS for RCP CCW and restore flow to the pumps (0.5).

B. 1. Signal cleared
2. Reset PPS (trip path)
3. Reset ESFAS (actuation path)

KEY:

ESF AOP CNTRL

REF:

ANO 2 STM-2-70

VAL:

A. AS INDICATED
B. 0.33 ea

3.8 On an SIAS condition, what basically happens to the Service Water/Auxiliary Cooling Water System? (8 items) (2.0)

ANS: (ANY EIGHT)

1. ACW supplies shut
2. SFPHX supplies shut
3. CCW HX supplies shut
4. Cooling tower makeup MOV's shut (SW loop 1 ACW return isolation 2CV1543-1 and SW loop 2 ACW return isolation 2CV1542-2)
5. Return MOV's to emergency pong open
6. Return MOV's to lake shut
7. SW pumps receive start signal
8. ESF header isolation open (loops I and II)
9. SW is lined up to the containment coolers (CCAS actuated by same setpoint and bistable as SIAS)
10. SW will be supplied to equipment actuated by SIAS which require SW cooling.

Note: "SW returns shift to the pond" may be substituted for 5 and 6 both but not either singularly.

KEY:

SWS ESF SI CNTRL

REF:

ANO 2 STM-2-42

VAL:

0.25 ea

3.9 Describe the actions of the Feedwater Control System under the following conditions: (2.5)

A. High level override
B. Reactor trip override

ANS:

A. 1. MFRV will shut
2. BFRV will shut
3. Feed pump program uses higher signal - 0% flow demand from its FWCS (minimum speed) or flow demand from the other FWCS

B. 1. Non-selected feed pump goes to minimum speed
2. MFRV shut
3. BFRV goes to 5% flow demand (enough to remove decay heat) (11-15% flow)
4. When flow signal less than 5%, auto returns to no override configuration.

KEY:

MFW CNTRL

REF:

ANO 2 STM-2-69

VAL:

A. 0.333 ea
B. 0.375 ea

3.10 List the 11 valves in the CVCS which receive ES signals and indicate the type of ES signal that each valve is capable of receiving. Valves may be listed by name or number. (3.0)

ANS:

1. Letdown line isolation (2CV-4820-2) - SIAS
2. Regenerative Hx inlet (2CV-4821-1) - SIAS or CIS
3. Regenerative Hx outlet (2CV-4823-2) - CIS
4. CBO isolation (2CV-4846-1) - CIS or SIAS
5. CBO isolation (2CV-4847-1) - CIS or SIAS
6. VCT outlet (2CV-4873-1) - SIAS
7. BAMT B recirc (2CV-4915-2) - SIAS
8. BAMT A recirc (2CV-4903-2) - SIAS
9. BAMT to charging pump suction (2CV-4916-2) - SIAS
10. Boric acid gravity feed to charging pps (2CV-4920-1) - SIAS
11. Boric acid gravity feed to charging pps (2CV-4921-1) - SIAS

KEY:

CVCS SI CNTRL VALVE

REF:

ANO 2 STM-2-04

VAL:

2,4, & 5 - 0.333 ea
all others 0.25 ea

3.11 TRUE or FALSE: (1.5)

A. The CPC uses average T_C to generate calibrated neutron flux power.

B. The incore flux power can be read on the plant power digital meter.

C. As containment ambient temperature increased, pressurizer level indicates higher.

ANS:

A. FALSE
B. FALSE
C. TRUE

KEY:

CPC NI PZR IND

REF:

ANO 2 STM-2-65, 67, 70

VAL:

0.5 ea

END OF CATEGORY 3

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

4.1 For operation with T_{ave} greater than or equal to 300°F, Technical Specifications require 2 independent ECCS subsystems OPERABLE. What constitutes an OPERABLE ECCS subsystem? (2.0)

ANS:

1. One OPERABLE high-pressure safety injection pump
2. One OPERABLE low-pressure safety injection pump
3. An independent OPERABLE flow path (0.25) capable of taking suction from the refueling water tank (0.25) on a SIAS (0.25) and automatically transferring suction to the containment sump on a RAS (0.25).

KEY:

TS ESF SI PATH

REF:

ANO 2 T.S. 3.5.2

VAL:

0.5 ea for 1 & 2
as indicated in 3

4.2 TRUE or FALSE: (2.0)

A. Positive manual reactivity additions by more than one method is acceptable below the point of adding heat.

B. All regualting CEA groups shall be withdawn in their prescribed sequence except for physics and surveillance tests.

C. The reactor operator can exceed 1.5 DPM startup rate only with the permission of the Shift Supervisor.

D. Criticality must be anticipated any time CEAs are being withdrawn or boron dilution operations are being performed.

ANS:

A. FALSE
B. TRUE
C. FALSE
D. TRUE

KEY:

NOP RODCNTRL LIMITS

REF:

ANO 2 OP 2102.08 SEC 4

VAL:

0.5 ea

4.3 Identify the procedural limits for the following plant operations: (2.0)

A. RCS cooldown rate above 225 ^{o}F.
B. Maximum pressurizer to RCS temperature differential.
C. Hydrogen concentration in the RCS during normal operations.
D. S/G levels during plant startup.

ANS

A. Do not exceed 100^{o}F/hr
B. 200^{o}F
C. 25-50 cc/kg
D. 60%

KEY:

NOP LMTS

REF:

ANO 2 OP 2102.02

VAL:

0.5 ea

4.4 During plant heatup, the operator observes that RCS temperature goes from 350°F to 362°F over a six minute period. Explain why this does or does not violate Technical Specifications for heatup rate. (1.5)

ANS:

While the heatup rate observed is 120°F/hr, TS are not violated because the limit is 100°F in a one hour period and the time interval was only six minutes.

KEY:

TS LMTS NOP

REF:

ANO 2 TS 3/4.4.9

VAL:

0.75 ea for TS limit and general discussion

4.5 During plant heatup, three graphs are to be plotted every 10 minutes (not to exceed 30 minutes). What are these graphs? (1.5)

ANS:

1. RCS pressure vs temperature
2. RCS temperature vs time
3. Pzr temperature vs time

KEY:

NOP JOB LMTS

REF:

ANO 2 OP 2102.02

VAL:

0.5 ea

4.6 During operation, you are informed by an auxiliary operator that the generator transformer is running hotter than usual. List three possible reasons why a transformer may run hotter than normal and appropriate corrective actions for each case. (1.5)

ANS: (ANY THREE)

1. Hi current - reduce load
2. Fault - unit shutdown
3. Oil breakdown - unit shutdown
4. Hi ambient temp - reduce load
5. Fan failure - start standby fan/reduce load
6. Pump failure - start standby pump/reduce load

KEY:

AOP ELEDST

REF:

ANO 2 STM-2-32

VAL:

0.2 ea for reason
0.3 ea for correction action

4.7 Why should CEA withdrawal be in small frequent steps when operating above 50% reactor power? (1.0)

ANS:

Prevent fuel failure (0.333) due to larage local power density changes (0.333) in the vicinity of CEA fingertips (0.333).

KEY:

NOP CORE LMTS

REF:

ANO 2 OP 2102.04

VAL:

AS INDICATED

4.8 TRUE or FALSE: (3.0)

A. LD-50/50 and LD-100/30 pertain to the percentageof those individuals who will die after 30 days of receiving a chronic dose.

B. G.M. tubes make good instruments for setting dose rate.

C. Tritium is a strong gamma emitter.

D. Teletector will monitor beta radiation only on the lower three scales.

E. Instruments that operate in the ion chamber region are energy dependent and indicat dose rates in Rem/hr as opposed to exposure in Rad/hr.

F. The shorter the half life of an isotope, the more radioactive (unstable) it is.

ANS:

A. FALSE
B. FALSE
C. FALSE
D. TRUE
E. TRUE
F. TRUE

KEY:

RADCON JOB DET LMTS

REF:

ANO 2 AA-52009-001

VAL:

0.5 ea

4.9 Give two reasons why the relative hazard from radiation is higher from internal sources than external sources. (2.0)

ANS: (ANY TWO)

1. No protection (shielding) from internal exposure

2. Particulate radiations (alpha & beta) have very high ionizing ability but travel only a short distance in tissue. The damage done internally is localized to a small area around the source but a great deal of damage is done.

3. The different chemical characteristics of the radionuclides cause some of them to concentrate in certain body tissues (I-131 thyroids, Sr-90 bone, etc.).

4. Bone seeking isotopes chemically bond to bone tissue and stay there. If the half life is long, the bone gets exposed to a lot of radiation for a long time.

KEY:

RADCON JOB

REF:

ANO 2 AA-52009-001

VAL:

1 pt ea

4.10 A. What are 3 indications or methods for detecting increased radioactivity in the secondary side of a S/G? (1.5)

B. In an emergency, after a reactor trip and SIAS, what immediate action may be required due to decreasing RCS pressure? (0.5)

C. What two RCS parameters must be monitored to ensure adequate core heat removal immediately after a reactor trip? (1.0)

ANS:

A. (ANY THREE)
1. Sample activity
2. Condenser off-gas activity
3. Sample cooler radiation
4. Main steam line radiation
5. Increased secondary system radiation

B. Secure RCP's

C. RCS flow (forced or natural circ)
Subcooling margin

KEY:

EOP IND CNTRL

REF:

ANO 2 EOP 2202.01, pgs 2, 3, 10, 11

VAL:

0.5 ea

4.11 During blackout conditions, an Emergency Diesel Generator (EDG) starts but fails to pick up its associated ESF bus: (3.0)

A. What are four conditions that may have prevented the EDG output breaker from closing onto its assigned bus?

B. Why must the operator take action to quickly energize the bus or stop the diesel?

ANS:

A. (ANY FOUR)
1. Improper EDG voltage
2. Improper EDG speed
3. Normal feeder breaker not open
4. Cross-tie feeder breaker not open
5. Bus lockout relays picked up.
6. Loss of/no DC power to breaker
7. Breaker fault
8. DC lockout
9. Breaker racked down

B. The bus must be energized to supply cooling water to the EDG to prevent damage.

KEY:

EOP EDG CNTRL

REF:

ANO 2 EOP 2202.01, pg 35

VAL:

A. 0.5 ea
B. 1 pt

4.12 During natural circulation cooldown. (2.5)

A. How will dT (T_h-T_c) differ for a constant cooldown rate with a high versus a low decay heat load? Why?

B. Why is higher dT (T_h-T_c) necessary at lower RCS temperature to maintain a constant natural circulation flow rate?

C. What are two reasons that the procedure forces RCS pressure reduction in steps while the RCS temperature is held relatively constant at 350°F?

ANS:

A Delta T will be higher for a higher heat load (0.5) to provide a higher flow rate due to a larger density difference (0.5).

B. At lower RCS temperature, a higher dT is required because the density change per °F decreases as temperature decreases.

C. 1. Use of Aux spray is minimized.
2. Makes voiding (Pressurizer level increase) easier to detect when T_{ave} and pzr level are held steady.

KEY:

AOP LMTS IND

REF:

ANO 2 AOP 2203.13, pgs 2, 3

VAL:

A. as indicated
B. 0.5 pt
C. 0.5 ea

END OF CATEGORY 4

NRC LICENSE EXAMINATION HANDOUT

EQUATIONS, CONSTANTS, AND CONVERSIONS

$\dot{Q} = \dot{m} * C_p * \text{deltaT}$ $\qquad$ $\dot{Q} = U * A * \text{deltaT}$

$P = P_o * 10^{\text{sur}*(t)}$ $\qquad$ $P = P_o * e^{t/T}$ $\qquad$ $SUR = 26/T$

$T = l^*/\rho + (\beta-\rho)/\bar{\lambda}\rho$ $\qquad$ $T = 1/(\rho-\beta)$ $\qquad$ $T = (\beta-\rho)/\bar{\lambda}\rho$

$\rho = (K_{eff}-1)/K_{eff} = \text{deltaK}_{eff}/K_{eff}$ $\qquad$ $\rho = l^*/TK_{eff} + \bar{\beta}_{eff}/(1+\bar{\lambda}T)$

$\lambda = \ln 2/t_{\frac{1}{2}} = 0.693/t_{\frac{1}{2}}$ $\qquad$ $\bar{\lambda} = 0.1 \text{ seconds}^{-1}$

$I = I_o * e^{-ux}$

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

$R/hr = 6*CE/d^2 \text{ feet}$

Water Parameters

1 gallon = 8.345 lb_m = 3.87 liters
1 ft^3 = 7.48 gallons
Density @ STP = 62.4 lb_m/ft^3 = 1 gm/cm^3
Heat of vaporization = 970 Btu/lb_m
Heat of fusion = 144 Btu/lb_m
1 atmosphere = 14.7 psia = 29.9 inches Hg.

Miscellaneous Conversions

1 curie = 3.7×10^{10} disintegrations per second
1 kilogram = 2.21 lb_m
1 horsepower = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 inch = 2.54 centimeters
degrees F = 9/5 degrees C + 32
degrees C = 5/9 (degrees F - 32)
1 Btu = 778 $ft\text{-}lb_f$

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

Facility: ANO Unit 2

Reactor Type: CE-PWR

Date Administered: 12/10/85

Examiner: S.L. McCrory

Candidate: _____

INSTRUCTIONS TO CANDIDATE:

READ THE ATTACHED INSTRUCTION PAGE CAREFULLY. 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	25			5. Theory of Nuclear Power Plant Operations, Fluids, and Thermodynamics
25	25			6. Plant Systems Design, Control and Instrumentation
25	25			7. Procedures - Normal, Abnormal, Emergency, and Radiological Control
25	25			8. Administrative Procedures Conditions, and Limitations
100				TOTALS

Final Grade _____%

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.
2. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.
3. Use black ink or dark pencil only to facilitate legible reproductions.
4. Print your name in the blank provided on the cover sheet of the examination.
5. Fill in the date on the cover sheet of the examination (if necessary).
6. Use only the paper provided for answers.
7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.
8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write on only one side of the paper, and write "Last Page" on the last answer sheet.
9. Number each answer as to category and number, for example, 1.4, 6.3.
10. Skip at least three lines between each answer.
11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.
12. Use abbreviations only if they are commonly used in facility literature.
13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.
14. Show all calcualtions, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.
15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.
16. If parts of the examination are not clear as to intent, ask questions of the examiner only.
17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.
18. When you complete your examination, you shall:
    a. Assemble your examination as follows:
        (1) Exam questions on top.
        (2) Exam aids - figures, tables, etc.
        (3) Answer pages including figures which are a part of the answer.
    b. Turn in your copy of the examination and all pages used to answer the examination questions.
    c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.
    d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.
    e. Do not dicuss the examination with other licensee staff personnel until the formal examination review is complete.

5. THEORY OF NUCLEAR POWER PLANT OPERATIONS, FLUIDS, AND THERMODYNAMICS

5.1 Given the conditions below, calculate the time required for reactor vessel bulk water temperature to reach 212°F. STATE ALL ASSUMPTIONS AND SHOW ALL WORK FOR FULL CREDIT. (3.0)

Conditions:

1. The reactor has been shutdown for 100 hours after a 250 day run at 100%.
2. ALL means of removing heat from the vessel are lost.
3. No circulation to the primary loops occurs.
4. Reactor vessel water is initially at 112°F and well mixed.
5. The reactor vessed head is de-tensioned but still sealed.

ANS:

ASSUMPTIONS

A. Vessel water volume = 3000 - 5000 cu. ft. (0.5)
B. Decay heat load = 0.1 - 0.5% rated thermal power (0.5)
C. Rated thermal power = 2750 - 2850 MW (0.5)
D. Water density = 59.8 - 61.8 lbm/cu.ft. (.25)
E. 57,000 Btu/min = 1 MW (.25)
F. 1 Btu will raise 1 lbm water 1°F (.25)

SOLUTION

G. Water Mass = AxD = 209,300 - 309,000 lbm (0.1)
H. Heat Load = BxCxE = 2-15 MW = 1.14 - 8.55×10^5 Btu/min (0.1)
I. Heat Required = FxGx(dT=100°) = 21 - 31×10^6 Btu (0.1)
J. Time Required = I/H = 24 - 272 min = 0.4 - 4.5 hours (.45)

KEY:

HTTRANS

REF:

BASIC CE REACTOR DESIGN, STEAM TABLES, BASIC HT&T

VAL:

as indicated in the answer.

5.2 A. What is the minimum reactivity that must be added to a critical reactor for it to be prompt critical? (1.0)

B. How much (by what factor) would power increase in one second at ANO 2 if it were prompt critical? (2.0)

ANS:

A. p (reactivity) GE beta effective (beta value = 0.005 -0.007)

B. $T = l^*/p + (B-p)/tp$ (0.5)
So for prompt critical neglect the delayed term so that
$T = l^*/p$ (.25)
$l^* = 10^{-4} - 10^{-5}$ sec (.25)
$p = 0.005 - 0.007$ (.25)
$T = .0014 - 0.02$ sec (.25)
$P/P_o = e^{t/T} = e^{(50 - 700)/1 \text{ sec}}$ (0.5)

KEY:

RXTH COREOPS

REF:

BASIC REACTOR THEORY

VAL:

1 pt for A, and as indicated for B.

5.3 A. Explain how neutron production and indicated count rate would change if the neutron sources were removed from the reactor while it was subcritical (K_{eff} less than 1). (2.0)

B. Explain how long it would take to reach a steady-state count rate when K_{eff} is increased from 0.990 to 0.999 if it took one minute to achieve a steady-state count rate when K_{eff} was increased from 0.90 to 0.99. (1.0)

ANS:

A. The count rate would decrease to a small value since the reaction is not self-sustaining (1.0). Neutron production would not go to zero since spontaneous and cosmic fissions still occur, but the indicated count rate could be 0 due to instrument limitations (1.0).

B. Longer (0.7) - 10 minutes OR 10 times as long (0.3).

KEY:

RXTH NEUT

REF:

BASIC REACTOR THEORY

VAL:

As indicated in the answer.

5.4 The ratio of Plutonium atoms to U^{235} atoms increases as the core ages. Explain what affect the ratio has on the following: (3.0)

A. Delayed neutron fraction
B. SUR
C. Doppler defect

ANS:

A. Delayed neutron fraction decreases because beta is less for plutonium.
B. SUR would be larger because beta decreased.
C. Doppler defect would increase because of more capture in Pu^{240}.

KEY:

CORE RXTH

REF:

ANO 2 RTTM CH 13

VAL:

3 pts, 1 pt ea

5.5 Beta is the fraction of all neutrons released by fission which are delayed: (2.5)

A. When comparing the individual Beta's from thermal fission of U^{235}, Pu^{239}, and fast fission of U^{238}, which is largest?

B. From BOL to EOL, does the average delayed neutron fraction increase, decrease, or remain the same? Explain.

C. Why is $Beta_{eff}$ less than Beta?

D. For equivalent positive reactivity additions to a critical reactor, will the SUR be larger or smaller at EOL compared to BOL?

ANS:

A. U^{238}
B. Decreases - U^{235} goes down while Pu^{239} goes up
C. $B_{eff} = B_{core} \times I_1 \times I_2$. I_1 and I_2 are importance factors based on the relative ability of delayed neutrons to cause thermal fission (I_1) and fast fission (I_2) the product of which is less than 1.
D. larger

KEY:

NEUT RXTH

REF:

ANO 2 RTTM CH 13

VAL:

0.5 pt ea for A, B, and D
1 pt for C

5.6 During a reactor startup, the operator stops regulating group CEAs at 144 steps on group 3. The source range count rate levels off at 1857 cps. The initial count rate was 400 cps at 0 steps withdrawn on regulating group 1, with K_{eff} = 0.940. (1.5)

A. Calculate the 1/M value for this control position.

B. What is the new value of K_{eff} at this condition?

ANS:

A. $1/M = CR_1/CR_2 = 400/1857 = 0.215$
(The candidate may calculate the source term using CR = $S/(1-K_{eff})$ and then calculate 1/M using $1/M = 1-K_{eff}$. This will generate a 1/M = .0129 based on a CR = 24. This is not an operationally meaningful value since K_{eff} must = 0 before the source level could be seen on the instruments. Give credit only if the candidate states that 1/M is based on source level.)

B. $$1/M = \frac{1 - K_{eff_2}}{1 - K_{eff_1}}$$

$1 - K_{eff_2} = (1-0.940) \times 0.215 = 0.9871$

KEY:

COREOPS REAC

REF:

ANO 2 RTTM CH 15

VAL:

0.5 pt for A
1 pt for B

5.7 TRUE or FALSE: (3.0)

A. The boron coefficient (worth) is more negative at a high boron concentrations.

B. Xenon concentration decreases over core life but the xenon worth remains the same.

C. One way to dampen a xenon oscillation is to insert a control rod into the region of the highest neutron flux.

D. The time it takes to achieve peak Xe conditions following a shutdown is independent of the initial equilibrium power level.

E. If the reactor period is cut in half, startup rate will be doubled.

F. The samarium worth never changes since it is flux independent.

ANS:

A. FALSE
B. FALSE
C. TRUE
D. FALSE
E. TRUE
F. FALSE

KEY:

POISION REAC

REF:

ANO 2 RTTM CHs 17 & 18

VAL:

0.5 pt ea

5.8 During cold shutdown conditions, the SIT's are filled and pressurized. Over ther next few days the plant is taken to 100% power. Temperature in containment rises as does the temperature in the SIT's. Given the following information, find how much gas must be vented to maintain pressure. (1.0)

$T_1 = 68^oF$
$T_2 = 100^oF$
$V_{total} = 1850\ ft^3$
$V_{water} = 1480\ ft^3$
$P_1 = 615$ psia
$P_2 = 615$ psia

ANS:

$$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$$

$$(PxV/T)_1 = \frac{615 \times (1850-1480)}{460+68} = 431$$

$$V_2 = \frac{431 \times (460+100)}{615} = 392$$

$392-370 = 22\ ft^3$ to be vented off

KEY:

FLUID

REF:

ANO 2 HTFFM CH 1

VAL:

0.5 ea for formualtion and final answer

5.9 Explain why a relief valve body-to-bonnet leak will produce superheated steam if it is located on a steam generator but will not if located on the pressurizer. Use the mollier diagram provided and assume approximately normal full power values for pressures.

(2.0)

ANS:

SEE ATTACHED MOLLIER DIAGRAM
Leakage from a valve is an isenthalpic process. Using mollier diagram, assume S/G pressure of 1000 psia and primary of 2200 psia and draw a straight line (constant enthalpy) we find 80°F superheat for 100 psia at 14.7 psia, but not when 14.7 psia is reached for 2200 psia.

KEY:

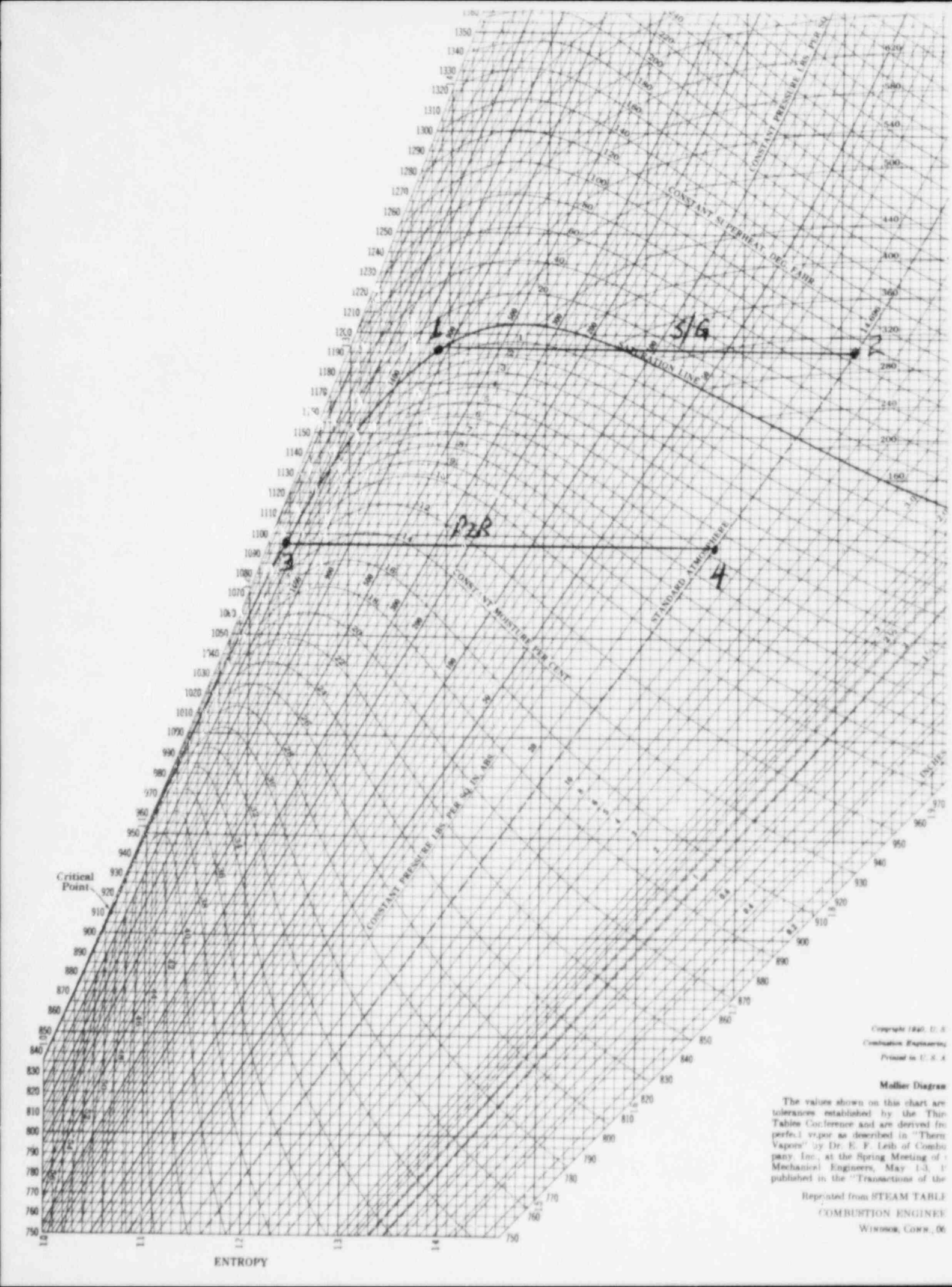
FLUID

REF:

ANO 2 HTFFM CH 2 & 4

VAL:

1 pt ea for use of mollier and explaination



Mollier Diagram

The values shown on this chart are tolerances established by the Thir Tables Conference and are derived fr perfect vapor as described in "Therm Vapors" by Dr. E. F. Leib of Combu pany, Inc., at the Spring Meeting of Mechanical Engineers, May 1-3, 1 published in the "Transactions of the

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Windsor, Conn., 06

5.10 A centrifugal pump is maintaining a flow rate of 1,000,000 lbm/hr and a discharge head of 200 psig at 1000 rpm with a power input of 300 Hp. If the pump head is doubled, what is the new flow rate, speed, and power. Show all work for full credit. (1.5)

ANS:

Pump laws:

$V=kN$

$h=kN^2$

$KW=kN^3$

N increases by the square root of 2

$V_f = V_i \times (SR\ 2) = 10^6 \times 1.414213 = 1{,}414{,}213$ lbm/hr

$N_f = N_i \times (SR\ 2) = 10^3 \times 1.414213 = 1{,}414$ RPM

$Hp_f = Hp_i \times (SR\ 2)^3 = 300 \times 2.828 = 848.5$ Hp

KEY:

FLUID

REF:

ANO 2 HTFFM CH 6

VAL:

0.5 ea

5.11 As the core ages, the delta T from the fuel centerline to the coolant changes. This will subsequently change the fuel temperature at full power. Provide five (5) factors that change over the life of the core which affect the heat transfer ability and subsequent full power centerline temperature. (1.5)

ANS: (ANY FIVE)

1. Fuel densification
2. Fuel pellet swelling
3. Clad creep
4. Clad corrosion
5. Crud buildup
6. Gas in the gap
7. Thickness (size) of the gap
8. Fuel pellet thermal conducitivity

KEY:

HTTRANS

REF:

ANO 2 HTFFM CH 8

VAL:

0.333 ea

END OF CATEGORY 5

6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION

6.1 A. What equipment (5 items) discharges to the Quench Tank?(1.5)

B. What three alarms are associated with the quench tank? (1.0)

C. If the Quench Tank level is too high, where can the operators discharge the excess water? (0.5)

ANS:

A. (ANY FIVE)
1. RCP seal water relief
2. Pressurizer safeties
3. LTOP's
4. ECCS vent
5. Reactor vessel head vent
6. Pressurizer high point vent
7. Nitrogen addition
8. Reactor makeup water addition

B. 1. Level hi/lo
2. Hi pressure
3. Hi temperature

C. Reactor coolant drain tank

KEY:

RCS TANK IND PATH

REF:

ANO 2 STM-2-03, FSAR 5-5

VAL:

A. 0.3 ea
B. 0.333 ea
C. 0.5

6.2 What indication does the operator have that the reactor vessel head inner gasket is leaking? (1.0)

ANS:

1. Leakage is detected by observing a rise in temperature on the leakoff line temperature indicator (2T1S-4662).

2. Leakage is also detected by the RCS RV head leakoff alarm (on 2K10, D4 setpoint 150°F).

KEY:

RCS IND SEALS

REF:

ANO 2 STM-2-02

VAL:

0.5 ea for temp and alarm

6.3 What five systems does the RWT provide water for? (1.5)

ANS: (ANY FIVE)
1. Containment spray
2. Lp safety injection
3. Refueling canal fill
4. Fuel pool makeup
5. CVCS makeup (emergency boration)
6. HPSI
7. SITs

NOTE: ECCS may be substituted for any one of HPSI, LPSI, or Containment Spray.

KEY:

MAKEUP TANK PATH

REF:

ANO 2 STM-2-08

VAL:

0.3 ea

6.4 With the plant at 15% power during a plant startup, the operator is maintaining steam generator levels with all FWCS Hand/Auto stations in "manual". (2.0)

A. What will the response of the FWCS be if a reactor trip occurs?

B. What are two problems this could create if there were no operator action to correct?

ANS:

A. Feed water flow will remain constant.

B. 1. Result in overfeeding the S/G
2. Overcool the RCS

KEY:

MFW CNTRL VALVE

REF:

ANO 2 STM-2-69

VAL:

A. 1 pt
B. 0.5 ea

6.5 List the three sources of water for EFW and state when each is used. (3.0)

ANS:

1. S/U and B/D Demin. effluent - low power(LT 10%)/shutdown
2. Condensate storage tanks - normal (GT 10%)
3. Service Water System - Emergency

KEY:

AFW PATH

REF:

ANO 2 STM-2-19

VAL:

0.5 ea

6.6 Describe the four flow paths or all fluids that are involved with each reactor coolant pump. (2.5)

ANS:

1. CCW through the outer tube of the seal cooling heat exchanger

2. RCS through the pump impeller

3. RCS pumped by the auxiliary impeller through the inner tube of the seal cooler.

4. Controlled bleedoff coming around the seals via pressure-reducing orifices after having baeen cooled by the auxiliary impeler and seal cooler function.

KEY:

RCS PUMP DESGN

REF:

ANO 2 STM-2-03

VAL:

0.5 ea for 1-3
1 pt for 4

6.7 During normal power operation, the two temperature sensing elements on the outlet of the letdown heat exchanger fail high. What control functions occur? (2.0)

ANS:

1. 2TE-4815 fails high - CCW flow controller valve from letdown heat exchanger will go full open (0.5).

2. 2TE-4805 fails high - this will isolate the letdown flow to the CVCS rad-monitors (0.5) and boronometer (0.5) and also bypass letdown flow around the demineralizers to the VCT(0.5). (This feature protects these components from high temperature conditions which they are not designed to handle.)

KEY:

CVCS CNTRL AOP VALVE

REF:

ANO 2 STM-2-4

VAL:

AS INDICATED (sensor designators not needed for full credit)

6.8 List six of the eight functions for which the 125 VDC Power System is designed to provide power. (2.0)

ANS: (ANY SIX)

1. 6.9 kV switchgear control
2. 4.16 kV switchgear control
3. 480V load control
4. Reactor control (control rod drive, reactor trip circuit breaker control)
5. Reactor instrumentation and protective system
6. Engineered Safeguards System
7. Inverters (vital 120 VAC)
8. Other equipment necessary for normal unit opertion, and normal and emergency shutdown. (any component operated with 125VDC)

KEY:

ELEDST CNTRL

REF:

ANO 2 STM-2-32

VAL:

0.333 ea

6.9 A. List the three dedicated CPC indications provided in the control room (do not list the digital display or any alarm/status lights). (1.0)

B. List the three dedicated COLSS indications provided in the control room (i.e., items that are permanently displayed vice assigned points normal on display). (1.0)

C. Why is the COLSS system not used for the reactor protection system? (1.0)

D. Which is more accurate COLSS or CPC's? (0.5)

ANS:

A. 1. Margin to DNB
2. Calibrated neutron flux
3. Margin to LPD

B. 1. Core power limit, based on margin to DNB
2. Core power limit, based on margin to LPD
3. Core power
Note: Linear power KW/FT/DNBR limit meter (2J19042/9040) may be substituted for either 1 or 2 but not both.

C. Too slow for indicating actual plant conditions during transients.

D. COLSS

KEY:

RPS IND DESGN

REF:

ANO 2 STM-2-65,66

VAL:

A. 0.333 ea
B. 0.333 ea
C. 0.5 ea for "too slow" and "transients"
D. 0.5

6.10 During full power operation, the CIAS inadvertently actuates.

A. What effect doe this have on continued plant operation and why? (1.5)

B. What is required to reset it? (1.0)

ANS:

A. CIAS actuation affects the operation of the plant by isolating the majority of auxiliary features fed into containment. Due to the requirements of CCW to cool the RCP's and seals (0.5), the plant will be tripped (0.5) and RCP's shutdown on receipt of a high temperature alarm from the RCP or after 5 minutes without CCW OR override CIAS for RCP CCW and restore flow to the pumps (0.5).

B. 1. Signal cleared
2. Reset PPS (trip path)
3. Reset ESFAS (actuation path)

KEY:

ESF AOP CNTRL

REF:

ANO 2 STM-2-70

VAL:

A. AS INDICATED
B. 0.33 ea

6.11 On an SIAS condition, what basically happens to the Service Water/Auxiliary Cooling Water System? (8 items) (2.0)

ANS: (ANY EIGHT)

1. ACW supplies shut
2. SFPHX supplies shut
3. CCW HX supplies shut
4. Cooling tower makeup MOV's shut (SW loop 1 ACW return isolation 2CV1543-1 and SW loop 2 ACW return isolation 2CV1542-2)
5. Return MOV's to emergency pong open
6. Return MOV's to lake shut
7. SW pumps receive start signal
8. ESF header isolation open (loops I and II)
9. SW is lined up to the containment coolers (CCAS actuated by same setpoint and bistable as SIAS)
10. SW will be supplied to equipment actuated by SIAS which require SW cooling.

Note: "SW returns shift to the pond" may be substituted for 5 and 6 both but not either singularly.

KEY:

SWS ESF SI CNTRL

REF:

ANO 2 STM-2-42

VAL:

0.25 ea

END OF CATEGORY 6

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

7.1 For operation with T_{ave} greater than or equal to 300°F, Technical Specifications require 2 independent ECCS subsystems OPERABLE. What constitutes an OPERABLE ECCS subsystem? (2.0)

ANS:

1. One OPERABLE high-pressure safety injection pump
2. One OPERABLE low-pressure safety injection pump
3. An independent OPERABLE flow path (0.25) capable of taking suction from the refueling water tank (0.25) on a SIAS (0.25) and automatically transferring suction to the containment sump on a RAS (0.25).

KEY:

TS ESF SI PATH

REF:

ANO 2 T.S. 3.5.2

VAL:

0.5 ea for 1 & 2
as indicated in 3

7.2 During plant heatup, the operator observes that RCS temperature goes from 350°F to 362°F over a six minute period. Explain why this does or does not violate Technical Specifications for heatup rate. (1.5)

ANS:

While the heatup rate observed is 120°F/hr, TS are not violated because the limit is 100°F in a one hour period and the time interval was only six minutes.

KEY:

TS LMTS NOP

REF:

ANO 2 TS 3/4.4.9

VAL:

0.75 ea for TS limit and general discussion

7.3 During plant heatup, three graphs are to be plotted every 10 minutes (not to exceed 30 minutes). What are these graphs? (1.5)

ANS:

1. RCS pressure vs temperature
2. RCS temperature vs time
3. Pzr temperature vs time

KEY:

NOP JOB LMTS

REF:

ANO 2 OP 2102.02

VAL:

0.5 ea

7.4 During operation, you are informed by an auxiliary operator that the generator transformer is running hotter than usual. List three possible reasons why a transformer may run hotter than normal and appropriate corrective actions for each case. (1.5)

ANS: (ANY THREE)

1. Hi current - reduce load
2. Fault - unit shutdown
3. Oil breakdown - unit shutdown
4. Hi ambient temp - reduce load
5. Fan failure - start standby fan/reduce load
6. Pump failure - start standby pump/reduce load

KEY:

AOP ELEDST

REF:

ANO 2 STM-2-32

VAL:

0.2 ea for reason
0.3 ea for correction action

7.5 Why should CEA withdrawal be in small frequent steps when operating above 50% reactor power? (1.0)

ANS:

Prevent fuel failure (0.333) due to larage local power density changes (0.333) in the vicinity of CEA fingertips (0.333).

KEY:

NOP CORE LMTS

REF:

ANO 2 OP 2102.04

VAL:

AS INDICATED

7.6 TRUE or FALSE: (3.0)

A. LD-50/50 and LD-100/30 pertain to the percentageof those individuals who will die after 30 days of receiving a chronic dose.

B. G.M. tubes make good instruments for setting dose rate.

C. Tritium is a strong gamma emitter.

D. Teletector will monitor beta radiation only on the lower three scales.

E. Instruments that operate in the ion chamber region are energy dependent and indicat dose rates in Rem/hr as opposed to exposure in Rad/hr.

F. The shorter the half life of an isotope, the more radioactive (unstable) it is.

ANS:

A. FALSE
B. FALSE
C. FALSE
D. TRUE
E. TRUE
F. TRUE

KEY:

RADCON JOB DET LMTS

REF:

ANO 2 AA-52009-001

VAL:

0.5 ea

7.7 A. What are 3 indications or methods for detecting increased radioactivity in the secondary side of a S/G? (1.5)

B. In an emergency, after a reactor trip and SIAS, what immediate action may be required due to decreasing RCS pressure? (0.5)

C. What two RCS parameters must be monitored to ensure adequate core heat removal immediately after a reactor trip? (1.0)

ANS:

A. (ANY THREE)
1. Sample activity
2. Condenser off-gas activity
3. Sample cooler radiation
4. Main steam line radiation
5. Increased secondary system radiation

B. Secure RCP's

C. RCS flow (forced or natural circ)
Subcooling margin

KEY:

EOP IND CNTRL

REF:

ANO 2 EOP 2202.01, pgs 2, 3, 10, 11

VAL:

0.5 ea

7.8 A. During recovery from blackout conditions the operator is directed to avoid any RCS cooldown. What are three reasons for this? (1.5)

B. During blackout what are four suggested actions to limit the drain on station batteries? (2.0)

ANS:

A. 1. No makeup available
2. No way to borate (SDM)
3. No way to maintain RCS pressure (voiding head)

B. (ANY FOUR)
1. Vent generator H_2 and stop DC seal oil pump.
2. Secure MFP DC powered lube oil pumps
3. Secure Main turbine DC powered lube oil pump
4. Secure plant computer if not required
5. Secure any unncessary DC lighting

KEY:

EOP ELEDST CNTRL

REF:

ANO 2 EOP 2202.01, pgs 56, 57

VAL:

0.5 ea

7.9 During natural circulation cooldown: (2.5)

A. How will dT (T_h-T_c) differ for a constant cooldown rate with a high versus a low decay heat load? Why?

B. Why is higher dT (T_h-T_c) necessary at lower RCS temperature to maintain a constant natural circulation flow rate?

C. What are two reasons that the procedure forces RCS pressure reduction in steps while the RCS temperature is held relatively constant at 350°F?

ANS:

A Delta T will be higher for a higher heat load (0.5) to provide a higher flow rate due to a lower density difference (0.5).

B. At lower RCS temperature, a higher dT is required because the density change per °F decreases as temperature decreases.

C. 1. Use of Aux spray is minimized.
2. Makes voiding (Pressurizer level increase) easier to detect when T_{ave} and pzr level are held steady.

KEY:

AOP LMTS IND

REF:

ANO 2 AOP 2203.13, pgs 2, 3

VAL:

A. as indicated
B. 0.5 pt
C. 0.5 ea

7.10 A. What is your 10CFR20 quarterly radiation exposure limit:
1. without form 4?
2. with form 4? (1.0)

B. What is your ANO recommended weekly exposure limit:
1. without form 4?
2. with form 4? (1.0)

ANS:

A. 1. 1.25 rem/qtr
2. 3 rem/qtr

B. 1. 100 mrem/week
2. 300 mrem/week

KEY:

RADCON JOB

REF:

ANO 2 AA-52009-001

VAL:

0.5 ea

7.11 Which of the following items are addressed in Technical Specifications? Indicate YES or NO for each item. (2.5)

A. Fuel Temperature Coefficient

B. Boration system heat tracing

C. Wind Direction Instrument

D. Lake Dardanelle Thermal Gradient

E. Chlorine Detection System

F. Loose stone (riprap) around the Emergency Cooling Pond

G. Main Condenser Evacuation System

H. 125 VDC Battery Terminal corrosion

I. Quick open response time for Steam Dump Bypass Valves

J. Spent Resin Tank curie content

ANS:

A. NO
B. YES - 3.1.2.8
C. YES - 3.3.3.4
D. NO
E. YES - 3.3.3.7
F. YES - 4.7.4.1
G. NO
H. YES - 4.8.2.3.1
I. NO
J. NO

REF:

ANO II TS AS INDICATED

Question value is 2.5 pts, 0.25 per item.

7.12 Explain how core exit thermocouples can provide indication of core uncovery. (1.0)

ANS:

If indicated temperature is greater than T_{sat} for that pressure (then the core exit TC's will be indicating a superheated temperature indicating partial core uncovery).

KEY:

EOP CORE IND

REF:

ANO 2 EOP's

VAL:

1 pt

END OF CATEGORY 7

8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS

8.1 TRUE or FALSE: (3.5)

A. A Shift Superviosr's responsibilities include the authorization of the initiation and restoration of temporary modifications prior to such acitivities taking place.

B. A 17-year old has a 5(N-18) = 0 accumulated exposure limit. Therefore, his dose is limited to 5% of the basic permissible of 1000 mrem per quarter.

C. If a power-operated valve is to be tagged with a hold card, both the power supply and handwheel shall be tagged.

D. A shift administrative assistant is not allowed to fill out the Hold Card Request Sheet and Hold Cards.

E. Fuel handling operations may include personnel who are unlicensed.

F. With one pressurizer code safety valve operable, reactor power is limited to less than or equal to 25%.

G. When RCS temperature is less than 200^{o}F, all reactor coolant pumps and shutdown cooling pumps may be de-energized for one hour.

ANS:

A. TRUE
B. FALSE
C. TRUE
D. FALSE
E. TRUE
F. FALSE
G. TRUE

KEY:

TS NOP CNTRL LMTS RADCON

REF:

ANO 2 OP's 1000.27, 1000.28, 1015.07, 2502.01 TS 3.4.3, 3.4.1.3

VAL:

0.5 ea

8.2 A. During cold shutdown (mode 5), what is the minimum shift complement? (1.0)

B. List the personnel required to carry out fuel handling operations (include transferring from Aux. Bldg. to Reactor Bldg. in manual). (1.5)

ANS:

A. 1 each of the following:
SRO
RO
Non-licensed operator
HP Tech

B. 1 each of the following:
CRO (Control Room Operator)
Spent fuel bridge operator (licensed)
Operator for upender Aux. Bldg.
Reactor fuel bridge operator (licensed)
Operator for upender in Reactor Bldg.
SRO at the Reactor fuel bridge area (in charge of fuel ops)

KEY:

NOP TS JOB

REF:

ANO 2 OP 1015.01

VAL:

0.25 ea

8.3 What four conditions require an independent review of tagout lineup and installation? (2.0)

ANS:

Independent verification of all tagouts is required.

KEY:

TAG JOB

REF:

ANO 2 OP 1000.27

VAL:

0.5 ea

8.4 For each of the following chemical analyses of the RCS, indicate:

1. Whether or not the concentration is within limits.
2. How to correct unsatisfactory conditions (i.e., outside normal operational limits).
3. The possible consequences of continued operation with the existing condition. (3.0)

A. Cl^- - 0.2 PPM
Fl^- - less than 0.1 PPM
O_2 - 0.1 PPM
(reactor power - 50%)

B. Cl^- - less than 0.1 PPM
Fl^- - less than 0.1 PPM
O_2 - 0.2 PPM
(reactor at standby)

ANS:

A. 1. Cl^- - w/i transient limit
Fl^- - sat
O_2 - sat
2. Increase CVCS flow rate (letdown)
3. Cl^- stress corrosion (time dependent)

B. 1. Cl^- - sat
Fl^- - sat
O_2 - w/i transient limit
2. Increase H_2 overpressure in VCT
3. O_2 stress corrosion (general oxidation)
Reduction of protective oxide film (time dependent)

KEY:

TS LMTS

REF:

ANO 2 TS 3/4.4.7

VAL:

0.5 each for the six subsets.

8.5 What is the basis for maintaining 23 feet of water above the core during refueling operations? (1.0)

ANS:

Ensures sufficient water depth is available to remove 99% of the assumed (10%) iodine gap activity (0.5) released from the rupture of an irradiated fuel assembly (0.5).

OR

Ensures sufficient heat sink to allow time to shift to alternate shutdown cooling or initiate emergency cooling to the core on loss of the operating shutdown cooling loop.

KEY:

TS RADCON

REF:

ANO 2 TS 3/4.9.9, Basis 3/4.9.8

VAL:

AS INDICATED

8.6 What is the basis for the Technical Specification limit on primary coolant specific activity? (1.5)

ANS:

Ensures that the resulting 2 hour doses at the site boundary will not exceed an appropriately small fraction of part 100 limits following a S/G tube rupture accident in conjunction with an assumed steady state primary-to-secondary leak rate of 1.0 gpm and a concurrent loss of offsite electrical power.

KEY:

TS RADCON LMTS RCS

REF:

ANO 2 TS 3/4.4.8

VAL:

0.25 for each underlined section

The following scenerio applies to questions 8.7 through 8.9. Use the Technical Specification extract provided to answer these questions.

The reactor has been operating for more than 100 hours at 100% power with all rods out. The core age is 100 EFPD. Operator error results in an inadvertant reactor trip with no actuation of ESF systems. Four hours after the trip reactor recovery has proceeded to the point that group 6 rods are at 134" when a minor CEA deviation alarm is received and the reactor operator notices that one of the group 6 rods is still at 130".

8.7 At this time would the rod be considered OPERABLE or INOPERABLE? Explain. (1.5)

ANS:

The rod is OPERABLE. As long as the deviation is less than 7", the LCO is met and the rod may be considered OPERABLE until further investigation shows otherwise.

KEY:

TS

REF:

ANO 2 TS 3.1.3.1

VAL:

0.5 pt for OP. or INOP.
1 pt for explanation

8.8 Attempts to move the affected rod individually are unsuccessful and the rest of the group 6 rods are positioned at 130".

With the information available up to this point, select the Technical Specification which most adequately covers the known condition and justify your selection. (To get credit, the reference must be given to the smallest subparagraph division (Ex: 3.4.1.2.a.2.b)). (1.5)

ANS:

TS 3.1.3.1
At this time nothing is known about the rod except that it will not respond to in/out signals from the control panel. AOP 2203.03, CEA Malfunctions, states that a rod is not declared to be INOPERABLE until it is known to be either untrippable or immovable. Therefore, no LCOs have been violated at this time.

KEY:

TS RODCNTRL

REF:

ANO 2 TS 3.1.3.1 and NRC precedent

VAL:

0.5 pt for TS and 1 pt for justification.

8.9 The fault is an open in the lift coils for the affected rod.

A. What, if any, alarms or annunciators would have been activated in the control room which are specific to the fault? (1.0)

B. With this information, what is the least restrictive appropriate Technical Specification statement? Justify your selection. (1.5)

C. With this condition, is the plant permitted by Technical Specifications to be operated at full power for an unspecified period of time? (0.5)

ANS:

A. None. There no alarms or annunciators which would specifically indicate an open in the lift coil of a rod. (This can only be determined by measuring the current across a shunt in the power line to each coil.)

B. 3.1.3.1.c - Since an electrical fault has been identified which would not have resulted from mechanical binding nor would interfere with tripping the rod, and alignment and insertion are in limits, this is the appropriate TS.

C. Yes

KEY:

TS RODCNTRL IND

REF:

ANO 2 TS 3.1.3.3

VAL:

A. - 1 pt
B. - 0.5pt for TS and 1 pt for justify
C. - 0.5

8.10 Which of the following conditions or events would result in an Emergency Action Level classification of "ALERT" or higher? Indicate yes or no for each one. (4.0)

A. Site experiencing straight winds greater than 75 mph.
B. Evacuation of the control room anticipated with control of shutdown systems established from local stations.
C. RCS leakage greater than 44 gpm but less than 100 gpm.
D. Area Radiation Monitors in the Reactor Building reading 2,500 mR/hr with no explanation.
E. Steam line break with 12 gpm primary to secondary leakage.
F. Dose equivalent I-131 of the RCS is 350 uCi/ml, not due to spiking.
G. Loss of all annunciator power indefinitely.
H. Loss of both shutdown cooling trains with anticipation of recovering at least one train in about 1 hour.

ANS:

A. NO
B. YES
C. NO
D. YES
E. NO
F. YES
G. YES
H. YES

KEY:

EPLAN

REF:

ANO 2 EPIP 1903.10

VAL:

4 pts, 0.5 each

8.11 A. What personnel make up the on-site fire brigade? (Give number of people from each source and the source.) (1.5)

ANS:

2 from affected unit
1 from unaffected unit
2 from security

KEY:

JOB

REF:

ANO 2 OP 1015.07

VAL:

0.5 ea

END OF CATEGORY 8

NRC LICENSE EXAMINATION HANDOUT

EQUATIONS, CONSTANTS, AND CONVERSIONS

$\dot{Q} = \dot{m} * C_p * \text{deltaT}$ $\qquad$ $\dot{Q} = U * A * \text{deltaT}$

$P = P_o * 10^{sur*(t)}$ $\qquad$ $P = P_o * e^{t/T}$ $\qquad$ $SUR = 26/T$

$T = l^*/\rho + (\beta - \rho)/\bar{\lambda}\rho$ $\qquad$ $T = 1/(\rho - \beta)$ $\qquad$ $T = (\beta - \rho)/\bar{\lambda}\rho$

$\rho = (K_{eff} - 1)/K_{eff} = \text{deltaK}_{eff}/K_{eff}$ $\qquad$ $\rho = l^*/TK_{eff} + \bar{\beta}_{eff}/(1 + \bar{\lambda}T)$

$\lambda = \ln 2/t_{\frac{1}{2}} = 0.693/t_{\frac{1}{2}}$ $\qquad$ $\bar{\lambda} = 0.1 \text{ seconds}^{-1}$

$I = I_o * e^{-ux}$

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

$R/hr = 6 * CE/d^2 \text{ feet}$

Water Parameters

1 gallon = 8.345 lb_m = 3.87 liters
1 ft^3 = 7.48 gallons
Density @ STP = 62.4 lb_m/ft^3 = 1 gm/cm^3
Heat of vaporization = 970 Btu/lb_m
Heat of fusion = 144 Btu/lb_m
1 atmosphere = 14.7 psia = 29.9 inches Hg.

Miscellaneous Conversions

1 curie = 3.7×10^{10} disintegrations per second
1 kilogram = 2.21 lb_m
1 horsepower = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 inch = 2.54 centimeters
degrees F = 9/5 degrees C + 32
degrees C = 5/9 (degrees F - 32)
1 Btu = 778 $ft\text{-}lb_f$

ERC-1853
12/12/85

ANO 2 EXAMINATION REPORT

ARKANSAS NUCLEAR ONE

UNIT TWO

REACTOR OPERATOR EXAM

OF 12/10/85

EXAM COMMENTS

Attachment 1

ANO 2 EXAMINATION REPORT

1.4 During a reactor startup, the operator stops regulating group CEAs at 144 steps on group 3. The source range count rate levels off at 1857 cps. The initial count rate was 400 cps at 0 steps withdrawn on regulating group 1, with Keff = 0.940 (1.5)

a. Calculate the 1/M value for this control position

b. What is the new value of Keff at this condition?

ANS:

a. $1/M = CR_1/CR_2 = 400/1857 = 0.215$

b. $1/M = 1 - Keff_2/1 - Keff_1$
$1 - Keff_2 = (1 - 0.940) \times 0.215 = 0.9871$

REF:

ANO-2 RTTM Chpt. 15

REQUESTED CHANGE

* Key answer is correct if you assume the source counts are 400.

However, since Keff was already .94 and the new Keff was .9871, then 1/M = 1 - K, would result in 1/M = .0129

Either answer .215 or .0129 should be accepted.

* DESIGNATES REQUESTED CHANGE

1.6 True or False

a. If the system temperature difference that is driving natural circulation flow is doubled, the heat removal rate will go up by slightly greater than a factor of two.

ANS:

* True

$\dot{Q} \propto \Delta T^{3/2}$

If ΔT increases by a factor of 2 $\dot{Q}$ will increase by a factor of $2^{3/2}$ or 2.8.

This should be considered "slightly" greater than 2 and answered True.

REF:

Heat Transfer Handbook Chapter 9 page 135

* DESIGNATES REQUESTED CHANGE

1.7 What four basic conditions must exist in order to create continuous flow due to natural circulation?

ANS:

* 1) Heat source

* 2) Heat sink

* 3) Flow path (hydraulic coupling)

* 4) Elevation difference (heat sink above heat source)

REF:

Heat Transfer Handbook Chapter 9 Page 133

* DESIGNATES REQUESTED CHANGE

1.9 Although the U^{238} resonance capture peaks broaden and flatten with increased fuel temperature, the area under the peak remains the same. Why then is there an increase in neutron capture as the fuel temperature is increased? (1.0)

ANS:

* Answer acceptable. Another answer should be "The reduction in self shielding"

REF:

ANO 2 RTTM Chapter 17

* DESIGNATES REQUESTED CHANGE

1.11 A. HOW does equilibrium Xenon reactivity (XE-eq) at hot full power change as a function of core age (EFPD)? (0.5)

B. WHY does Xe-eq change as a function of core age?

ANS:

A. Xe-eq gets larger as a function of core age.
B. Xe-eq is a function of flux not power (0.75) and flux increases as a function of core age. (0.75)

* B. Question not clear. If Xe-eq reactivity worth is asked for, then it is larger because of reduced competition from boron. If concentration is being asked for, then the concentration decreases because of increased burnout.

* DESIGNATES REQUESTED CHANGE

ANO 2 EXAMINATION REPORT

2.2A What equipment (5 items) discharges to the Quench Tank? (1.5)

ANS:

A. 1) RCP Seal Water Relief (RCP Control Bleedoff Relief)
2) Pressurizer Safeties
3) LTOPs
4) ECCS Vent
5) Reactor Vessel Head Vent
* 6) Pressurizer High Point Vent
* 7) Nitrogen Addition
* 8) Reactor Makeup Water Addition

REF:

P&ID M-2230 H1

* DESIGNATES REQUESTED CHANGES/ADDITIONS

2.3 What indication does the operator have that the reactor vessel head inner gasket is leaking? (1.0)

ANS:

* 1) Leakage is detected by observing rise in temperature on leakoff line temperature indicator. (2T1S-4662)

2) Leakage also detected by RCS RV head leakoff alarm (set point 150°F on 2K10, D4).

* Question did not ask for alarm setpoint. .5 for indication .5 for alarm

REF:

P&ID M-2230

* DESIGNATES REQUESTED CHANGE/ADDITION

2.4 What five systems does the RWT provide water for? (1.5)

ANS:

1) Containment spray
2) LP safety injection
3) Refueling canal
4) Fuel pool makeup
* 5) CVCS makeup (emergency boration)
6) HPSI
* 7) SITs

* ECCS may be listed instead of HPSI, LPSI, and Containment Spray

REF:

P&ID M-2231 & M-2236

* DESIGNATES REQUESTED CHANGE/ADDITION

3.1 List the 12 setpoints with their control/alarm functions associated with the pressurizer level control system.

ANS:

	13.2%	HI-HI Level Alarm
	12.5%	HI-HI Level Alarm clear
	11.1%	Letdown max.
*	4.5%	HI Level Alarm, all heaters on, backup signal to stop all backup charging pumps
	3.8%	Clear signal to turn on all heaters, HI Level Alarm clears
*	0.0%	Level setpoint (no associated contro/alarm functions)
	-1.4%	Letdown to minimum, stop 1st B/U charging pump
*	-2.0%	Stop 2nd B/U charging pump
	-3.1%	Start 1st B/U charging pump
	-4.2%	Clear backup signal to start all backup charging pumps LOW Level Alarm clears
	-4.8%	Start 2nd B/U charging pump
	-5.2%	B/U signal to start all charging pumps, LOW Level Alarm
*	29.0%	(Actual Level) LO-LO Level Alarm & Heater Cutout

* Request change tolerance for setpoint to ± 1.0%. Understanding of system response if more important than actual setpoint.

REF:

E-2704

* DESIGNATES REQUESTED CHANGE/ADDITION

3.2 During normal power operation, the two temperature sensing elements on the outlet of the letdown heat exchanger fail high. What control functions occur? (2.0)

ANS:

* Agree with key with the exception of naming the 2TE-4815 an 2TE-4805

* DESIGNATES REQUESTED CHANGE

3.3 List six of the eight functions for which the 125VDC power system is designed to provide power.

ANS:

1. 6.9 KV Switchgear Control
2. 4.16 KV Switchgear Control
3. 480V Load Center Control
* 4. Reactor Control (Control Rod Device, Reactor Trip Circuit Breaker Control)
5. Reactor Inst. and Protective System
6. Engineered Safeguards System
7. Inverters (Vital 120VAC)
8. Other equipment necessary for normal unit operation, and normal and emergency shutdown. (Any component operated with 125VDC)

REF:

ANO 2 STM-2-32

* DESIGNATES REQUESTED CHANGE

3.6 List the three dedicated COLSS indications provided in the Control Room (i.e., items that are permanently displayed, vice assigned points normally on display)

ANS:

* Agree with key, however, student may have listed the core power limit based on margin to DNB or LPD AS Linear Power KW/FT/DNBR limit meter (2J19042/9040). This is the way it is labeled on Panel 2C03.

REF:

Plant Panel 2C03

* DESIGNATES REQUESTED CHANGE/ADDITION

3.7 During full power operation, the CIAS inadvertently actuates.

A. What effect does this have on continued plant operation and why?

B. What is required to reset it?

ANS:

* A. Agree with key, however, we need to add capability to override and restore CCW to RCPs (as per DCP 84-2058)

B. 1) Signal cleared
* 2) Reset PPS (trip path)
* 3) Reset ESFAS (actuation path)
4) Reset components

* 4) "Reset Component" is not needed to reset a CIAS.

REF:

DCP 84-2058
OP2202.01 B.2 Page 70 of 138

* DESIGNATES REQUESTED CHANGE/ADDITION

3.8 On an SIAS condition, what basically happens to the Service Water/ Auxiliary Cooling Water System? (8 items)

ANS:

1) ACW supplies shut
2) SFPHX supplies shut
3) CCW HX supplies shut
* 4) Cooling tower makeup MOVs shut
(the procedure names these however they are labeled
a. SW Loop 2 ACW Return Isolation 2CV1542-2
b. SW Loop 1 ACW Return Isolation 2CV1543-1)
5. Return MOVs to emergency pond open
6) Return MOVs to lake shut
7) SW pumps receive start signal
* 8) ESF header isolations open (Loop I & Loop II)
* 9) SW is lined up to the containment coolers (CCAS actuated by same setpoint & bistable as SIAS)
* 10) Equipment such as EDG and room coolers are actuated on SIAS. An interlock will then open the SW valves associated with the equipment.

* #5 & #6 can be covered by saying that SW returns shift to the pond

REF:

P&ID M2210 Sheet 1-3

* DESIGNATES REQUESTED CHANGE/ADDITION

3.9 Describe the actions of the Feedwater Control System under the following conditions:

A. High Level Override

B. Reactor Trip Override

ANS:

A. 1) MFRV will shut
2) BFRV will shut
* 3) Feed pump program uses higher signal - 0% flow demand from ITS FWCS (minimum speed) or flow demand from other FWCS

* B. 1) Selected MFP trips on turbine trip (this function not due to RTO occurs due to turbine trip)
2) Feed pump goes to minimum speed
3) MFRV shuts
* 4) BFRV goes to a position corresponding to a 5% flow demand signal (actual valve position ~ 11-15%, enough flow to remove decay heat)
* 5) When flow demand signal is less than 5%, auto returns to no override configuration

REF:

AA52002-015

* DESIGNATES REQUESTED CHANGES/ADDITIONS

4.3 Identify the procedural limits for the following plant operations:

A. RCS cooldown rate above 225°F
B. Maximum pressurizer to RCS temperature differential
C. Hydrogen concentration in the RCS during normal operations
D. S/G levels during plant startup

ANS:

A. Do not exceed 100°F/hr
* B. 200°F or 350°F (see note)
C. 25-50 cc/kg
* D. 60%

* B. 200°F is the limit we attempt to maintain but exceeding this only requires logging the spray cycle. The question using the word maximum will probably be construed as 350°F due to notes in OP2102.02 Attachment "A". Due to wording of the question either answer should be acceptable.

* D. OP2102.02, this has been changed to 60% S/G level for startup due to S/G trip setpoints being changed allowing more room for operation between trip setpoints.

REF:

OP2102.02, Attachment "A"

* DESIGNATES REQUESTED CHANGE/ADDITION

4.6 During operation, you are informed by an auxiliary operator that the generator transformer is running hotter than usual. List three possible reasons why a transformer may run hotter than normal and appropriate corrective actions for each case. (1.5)

ANS:

(Any three)

1) Hi current-reduce load
2) Fault - unit Shutdown
3) Oil breakdown - unit shutdown
4) Hi ambient temp - reduce load
* 5) Fan failure - start standby fan/reduce load
* 6) Pump failure - start standby pump/reduce load

KEY:

AOP ELEDST

REF:

ANO 2 STM-2-32

VAL:

0.2 each for reason
0.3 each for corrective action

* DESIGNATES REQUESTED CHANGE/ADDITION

4.9 Give two reasons why the relative hazard from radiation is higher from internal sources than external sources. (2.0)

ANS:

(Any Two)

1) No protection (shielding) from internal exposure
2) Particulate radiations (alpha & beta) have very high ionizing ability but travel only a short distance in tissue. The damage done internally is localized to a small area around the source but a great deal of damage is done.
3) The different chemical characteristics of the radionuclides cause some of them to concentrate in certain body tissues (I-131 thyroids, SR-90 bone, etc.).
4) Bone seeking isotopes chemically bond to bone tissue and stay there. If the half life is long, the bone gets exposed to a lot of radiation for a long time.

* Other reasonable answers should be excepted i.e., continuous exposure due to inability to place distance between you and source.

KEY:

Radcon Job

REF:

ANO 2 AA-52009-001 and AE-10101-042

VAL:

1 point each

* DESIGNATES REQUESTED CHANGE/ADDITION

4.11 During blackout conditions, and emergency diesel generator (EDG) starts but fails to pick up its associated ESF bus:

A. What are four conditions that may have prevented the EDG output breaker from closing onto its assigned bus?

B. Why must the operator take action to quickly energize the bus or stop the diesel?

ANS:

A. (Any four)

1) Improper EDG voltage
2) Improper EDG speed
3) Normal feeder breaker not open
4) Cross-tie feeder breaker not open
5) Bus lockout relays picked up
* 6) Loss of/no DC power to brk
* 7) Breaker fault
* 8) DC lockout
* 9) Breaker racked down

* The above should be added as possibilities for the brk not auto closing, since no specific reference was asked.

REF:

ANO 2 OP2202.01, Page 35, E-2100 Sheet 1 and E-2076

VAL:

A. 0.5 each
B. 1 pt

* DESIGNATED REQUESTED CHANGES/ADDITIONS

ARKANSAS NUCLEAR ONE

UNIT TWO

SENIOR REACTOR OPERATOR EXAM

OF 12/10/85

EXAM COMMENTS

Attachment 1

5.6 During a reactor startup, the operator stops regulating group CEAs at 144 steps on group 3. The source range count rate levels off at 1857 cps. The initial count rate was 400 cps at 0 steps withdrawn on regulating group 1, with Keff = 0.940 (1.5)

a. Calculate the 1/M value for this control position

b. What is the new value of Keff at this condition?

ANS:

a. $1/M = CR_1/CR_2 = 400/1857 = 0.215$

b. $1/M = 1 - Keff_2/1 - Keff_1$
$1 - Keff_2 = (1 - 0.940) \times 0.215 = 0.9871$

REF:

ANO-2 RTTM Chpt. 15

REQUESTED CHANGE

* Key answer is correct if you assume the source counts are 400.

However, since Keff was already .94 and the new Keff was .9871, then 1/M = 1 - K, would result in 1/M = .0129

Either answer .215 or .0129 should be accepted.

* DESIGNATES REQUESTED CHANGE

5.8 During cold shutdown conditions, the SITs are filled and pressurized. Over the next few days the plant is taken to 100% power. Temperature in containment rises as does the temperature in the SITs. Given the following information, find how much gas must be vented to maintain pressure.

$T_1 = 68°F$

$T_2 = 100°F$

$V_{total} = 1850\ ft^3$

$V_{water} = 1480\ ft^3$

$P_1 = 615$ psia

$P_2 = 615$ psia

ANS:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{P_1V_1}{T_1} = \frac{615(1850\text{-}1480)}{460 + 68} = 431$$

$$\text{½} = \frac{431(460 + 100)}{615} = 392$$

392 370 = 22 ft^3

* This answer is acceptable, however, a more accurate approach would consider the increase in water volume due to the temperature increase

$$(1480\ ft^3)\ \frac{100°}{68°} = \frac{.016130}{.016006}\ (1480) = 1487.7$$

which represents ~ 8 ft^3 increase

total gas vented = 22 + 8 = 30 ft^3

* DESIGNATES REQUESTED CHANGES/ADDITIONS

6.1 What equipment (5 items) discharges to the Quench Tank? (1.5)

ANS:

A. 1) RCP Seal Water Relief (RCP Control Bleedoff Relief)
2) Pressurizer Safeties
3) LTOPs
4) ECCS Vent
5) Reactor Vessel Head Vent
* 6) Pressurizer High Point Vent
* 7) Nitrogen Addition
* 8) Reactor Makeup Water Addition

* Agree with key, request addition of additional sources

REF:

P&ID M-2230 H1

* DESIGNATES REQUESTED CHANGES/ADDITIONS

6.2 What indication does the operator have that the reactor vessel head inner gasket is leaking? (1.0)

ANS:

* 1) Leakage is detected by observing rise in temperature on leakoff line temperature indicator. (2T1S-4662)

2) Leakage also detected by RCS RV head leakoff alarm (set point 150°F on 2K10, D4).

* Question did not ask for alarm setpoint. .5 for indication .5 for alarm

REF:

P&ID M-2230

* DESIGNATES REQUESTED CHANGE/ADDITION

6.3 What five systems does the RWT provide water for? (1.5)

ANS:

1) Containment spray
2) LP safety injection
3) Refueling canal
4) Fuel pool makeup
* 5) CVCS makeup (emergency boration)
6) HPSI
* 7) SITs

* ECCS may be listed instead of HPSI, LPSI, and Containment Spray

REF:

P&ID M-2231 & M-2236

* DESIGNATES REQUESTED CHANGE/ADDITION

6.7 During normal power operation, the two temperature sensing elements on the outlet of the letdown heat exchanger fail high. What control functions occur? (2.0)

ANS:

* Agree with key with the exception of naming the 2TE-4815 an 2TE-4805

* DESIGNATES REQUESTED CHANGE

6.8 List six of the eight functions for which the 125VDC power system is designed to provide power.

ANS:

1. 6.9 KV Switchgear Control
2. 4.16 KV Switchgear Control
3. 480V Load Center Control
* 4. Reactor Control (Control Rod Device, Reactor Trip Circuit Breaker Control)
5. Reactor Inst. and Protective System
6. Engineered Safeguards System
7. Inverters (Vital 120VAC)
8. Other equipment necessary for normal unit operation, and normal and emergency shutdown. (Any component operated with 125VDC)

REF:

ANO 2 STM-2-32

* DESIGNATES REQUESTED CHANGE

6.9B List the three dedicated COLSS indications provided in the Control Room (i.e., items that are permanently displayed, vice assigned points normally on display)

ANS:

* Agree with key, however, student may have listed the core power limit based on margin to DNB or LPD AS Linear Power KW/FT/DNBR limit meter (2J19042/9040). This is the way it is labeled on Panel 2C03.

REF:

Plant Panel 2C03

* DESIGNATES REQUESTED CHANGE/ADDITION

6.10 During full power operation, the CIAS inadvertently actuates.

A. What effect does this have on continued plant operation and why?

B. What is required to reset it?

ANS:

* A. Agree with key, however, we need to add capability to override and restore CCW to RCPs (as per DCP 84-2058)

B. 1) Signal cleared
* 2) Reset PPS (trip path)
* 3) Reset ESFAS (actuation path)
4) Reset components

* 4) "Reset Component" is not needed to reset a CIAS.

REF:

DCP 84-2058
OP2202.01 B.2 Page 70 of 138

* DESIGNATES REQUESTED CHANGE/ADDITION

6.11 On an SIAS condition, what basically happens to the Service Water/ Auxiliary Cooling Water System? (8 items)

ANS:

1) ACW supplies shut
2) SFPHX supplies shut
3) CCW HX supplies shut
* 4) Cooling tower makeup MOVs shut
(the procedure names these however they are labeled
a. SW Loop 2 ACW Return Isolation 2CV1542-2
b. SW Loop 1 ACW Return Isolation 2CV1543-1)
5. Return MOVs to emergency pond open
6) Return MOVs to lake shut
7) SW pumps receive start signal
* 8) ESF header isolations open (Loop I & Loop II)
* 9) SW is lined up to the containment coolers (CCAS actuated by same setpoint & bistable as SIAS)
* 10) Equipment such as EDG and room coolers are actuated on SIAS. An interlock will then open the SW valves associated with the equipment.

* #5 & #6 can be covered by saying that SW returns shift to the pond

REF:

P&ID M2210 Sheet 1-3

* DESIGNATES REQUESTED CHANGE/ADDITION

7.4 During operation, you are informed by an auxiliary operator that the generator transformer is running hotter than usual. List three possible reasons why a transformer may run hotter than normal and appropriate corrective actions for each case. (1.5)

ANS:

(Any three)

1) Hi current-reduce load
2) Fault - unit Shutdown
3) Oil breakdown - unit shutdown
4) Hi ambient temp - reduce load
* 5) Fan failure - start standby fan/reduce load
* 6) Pump failure - start standby pump/reduce load

KEY:

AOP ELEDST

REF:

ANO 2 STM-2-32

VAL:

0.2 each for reason
0.3 each for corrective action

* DESIGNATES REQUESTED CHANGE/ADDITION

7.8 A. During recovery from blackout conditions the operator is directed to avoid any RCS cooldown. What are three reasons for this? (1.5)

B. During blackout what are four suggested actions to limit the drain on station batteries?

ANS:

(Any Three)

A. 1) No makeup available
2) No way to barate
3) No way to maintain RCS pressure
* 4) Steam pressure to low to run steam driven EFW pump (2P7A)

(Any Four)

B. 1) Vent generator H_2 and stop DC seal oil pump
2) Secure MFP DC powered lube oil pumps
3) Secure main turbine DC powered lube oil pump
4) Secure plant computer if not required
5) Secure any unnecessary DC lighting

KEY:

EOP ELEDST Cntrl

REF:

ANO 2 EOP2202.01, Page 56, 57

VAL:

0.5 each

* DESIGNATES REQUESTED CHANGE

8.1D True or False

A shift administrative assistant is not allowed to fill out the Hold Card Request Sheet and Hold Cards.

ANS:

* The shift administrative assistant is not specifically addressed in the latest revision of OP1000.27 Revision 4. The shift administrative assistant's qualifications vary and their ability to prepare tagouts is dealt with on a case to case basis. Question 8.1 may be answered yes or no.

REF:

OP1000.27 Rev. 4

* DESIGNATES REQUESTED CHANGE

8.3 What four conditions require an independent review of tagout lineup and installation?

ANS:

* Revision 4 of 1000.27 dated 5/21/85 requires an independent verification for all tagouts.

REF:

OP1000.27 Rev. 4 Pages 9 & 11
(Included as Attachment 1)

* DESIGNATES REQUESTED CHANGES

8.5 What is the basis for maintaining 23 feet of water above the core during refueling operations?

ANS:

* T.S. Bases 3/4.9.8 "Shutdown Cooling and Coolant Circulation" also contains an explanation of the 23 feet of water requirement and may be included in the examinee's response.

REF:

T.S. Bases 3/4.9.8

* DESIGNATES REQUESTED CHANGE

8.8 Attempts to move the affected rod individually are unsuccessful and the rest of the group 6 rods are position at 130".

With the information available up to this point, select the Technical Specification which most adequately covers the known condition and justify your selection.

ANS:

* At this time nothing is known about the rod except that it will not respond to in/out signals from the control panel. As per attached abnormal operating Procedure 2203.03 Rev. 2 dated 11/26/85, the rod would first be investigated and not assumed to be intrippable until verified to be so.

REF:

OP2203.03 Rev. 2 (New Procedure Revision) (Included as Attachment 2)

* DESIGNATES REQUESTED CHANGE

8.10 Which of the following conditions or events would result in an Emergency Action Level classification of "Alert" or higher?

ANS:

* Answers to question 8.10 are subject to interpretation. Answer to the questions should be accepted with the appropriate assumptions. For example, part 8.10D requires a loss of control of radioactive material and 8.10.G is not applicable above cold shutdown. The examinee's response may be yes or no depending on assumed situations.

REF:

OP1903.10

* DESIGNATES REQUESTED CHANGE