Docket No. 50-528

APR 27 1984

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E. E. Van Brunt, Jr.
Vice President, Nuclear
Arizona Public Service Company
P. O. Box 21666
Phoenix, Arizona 85036

Dear Mr. Van Brunt:

SUBJECT: EXAMINATION REPORT

On March 19-22, 1984, NRC administered examinations to employees of your company who had applied for licenses to operate your Palo Verde Nuclear Power Station. At the conclusion of the examinations, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed examination report (50-528) OL-84-01.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in NRC's Public Document Room unless you notify this office by telephone within ten days of the date of this letter and submit written application to withhold information contained therein within thirty days of the date of this letter. Such application must be consistent with the requirements of 2.790(b)(1).

Should you have any questions concerning this letter, please contact us.

Sincerely,

orig signed

D. F. Kirsch, Chief
Reactor Safety Branch
Division of Reactor Safety and
Projects

Enclosures:
1. Examination Report
2. Examination(s) and Answer Key(s) (SRO/RO)

cc:
Plant Superintendent
Plant Training Manager
Examiner

RV

O'Brien/dot	Pate	Kirsch
4/18/84	4/26/84	4/27/84

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PDR ADOCK 05000528
Q PDR

IE01
1/1

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— MASTER —

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

Facility: Palo Verde - Unit 1
Reactor Type: CE-PWR
Date Administered: March 20, 1984
Examiner: O'Brien, J. P.
Candidate: ____________

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

Category Value	% of Total	Candidate's Score	% of Category Value		Category
25.0	25.0			5.	Theory of Nuclear Power Plant Operation, Fluids, and Thermodynamics
25.0	25.0			6.	Plant Systems Design, Control, and Instrumentation
25.0	25.0			7.	Procedures - Normal, Abnormal, Emergency, and Radiological Control
25.0	25.0			8.	Administrative Procedures, Conditions, and Limitations
100.0		Final Grade			Totals

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

____
Candidate's Signature

5.0 Theory of Nuclear Power Plants Operation, Fluids and Thermodynamics

5.1 Frequent mention is made in the technical specifications and elsewhere that safety limits are placed on Departure from Nucleate Boiling Ratio (DNBR) and Linear Heat Ratio (LHR).

(1.5) a) Describe what will happen if either limit is exceeded (DNBR less than 1.2, LHR greater than 21.0 kw/ft.).

(0.5) b) If one limit is violated, does this mean that the other limit is also violated? Explain.

(0.5) c) How is the plant protected from exceeding these limits, assuming no operator action?

5.2 In June 1980, during a natural circulation cooldown, a steam void was produced in the vessel head at St. Lucie.

(1.25) a) Explain how it is possible to form such a void when control room indications show that the RCS is subcooled?

(1.25) b) Explain how pressurizer level would respond if the backup heaters are energized in this instance. Assume normal pressurizer level, initially.

5.3 During equilibrium 100% power operation, a control rod drops into the core.

(1.5) a) Explain, How and Why a dropped rod will affect the minimum DNBR in the core.

(1.5) b) Explain, How and Why the minimum DNBR changes during the next two hours if the rod is not recovered during this time (assume no operator action).

5.4

(1.0) a) During normal 100% power operation why is it important to control the pH on the secondary side of the steam generators?

(1.0) b) How is pH controlled on the secondary side of the steam generator?

(1.0) c) Why is Hydrazine added to the secondary side of the S/G?

5.5 During a reactor startup, a plot of inverse count rate versus rod position is shown in figure 5.5. Boric acid concentration in the RCS was maintained constant during the approach to criticality with the core at xenon free condition.

(1.0) a) Show how the slope of the curve would be affected if another person does not wait as long before reading count rate and rod position data, than the original person who plotted figure 5.5 (assume no rod motion at point of taking count rate data).

(1.0) b) Why is it unconservative to take count rate data too quickly?

5.6

(1.0) a) Define moderator temperature coefficient (MTC).

(2.0) b) Why does increasing the moderator temperature affect core reactivity? (give your best two (2) reasons)

(0.5) c) As the core ages, the MTC becomes more negative due to decreased boron but also to some extent due to the effects of fission product buildup. Explain why this buildup makes the MTC more negative.

5.7

(1.0) a) What are the production and removal mechanisms for Xenon?

(1.0) b) What are the production and removal mechanisms for Samarium?

(1.0) c) Why does the equilibrium value of Xenon increase with power while the equilibrium value of Samarium remains constant?

5.8 After two months of 100% operation, a moisture separator reheater safety valve fails open.

(2.0) a) How and Why would the reactor regulating system move the control rods? (assume automatic sequential mode)

5.9 (1.0) Primary flow rate is roughly ten times secondary flow rate, while primary heat transfer rate equals secondary heat transfer rate. Explain why the flow rates are different.

5.10 Cores A and B are "IDENTICAL" in design and operating parameters except that the control rod speed of core A is greater (higher) than the control rod speed of core B. Assuming a reactor startup of both cores commences at exactly the same time (rod withdrawal commences):

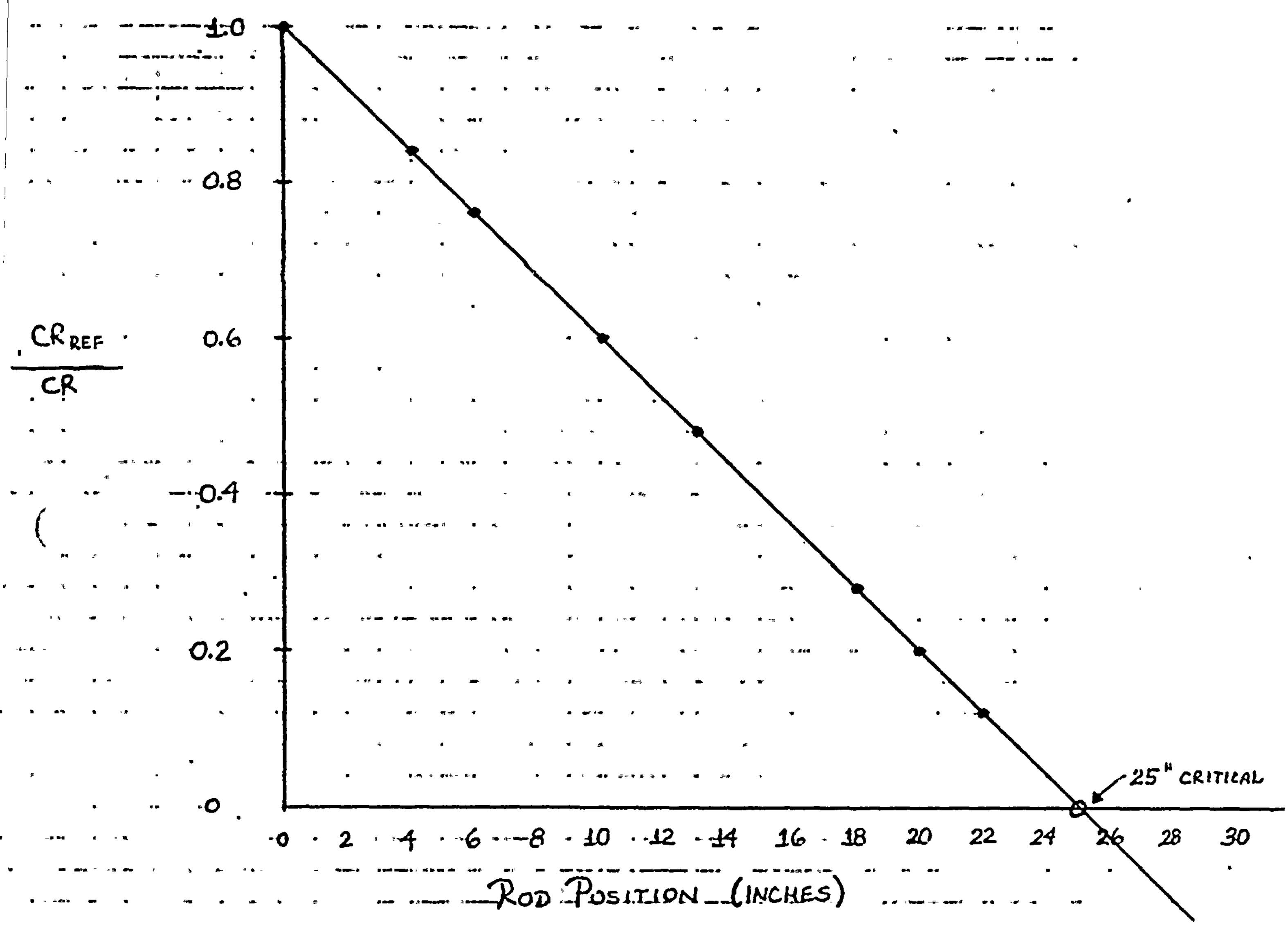
(0.5) a) Which core will achieve criticality first (A, B, or both critical at same time)?

(0.5) b) Which core will have a higher rod position at criticality (A, B, or both critical at same height)?

(0.5) c) Which core will have a higher indicated neutron power level the moment the reactor is critical (A or B)?

(1.0) d) Explain why for (c).

FIGURE 5.5



1.0
0.8
0.6
0.4
0.2
0
$\frac{CR_{REF}}{CR}$
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
25" CRITICAL
ROD POSITION (INCHES)

6.0 Plant Systems Design, Control and Instrumentation

6.1 Indicate what ESFAS actuation signals will be energized by the following:

(1.5) a) 2 out of 4 containment pressure greater than 5 PSIG.

(0.5) b) 2 out of 4 low steam generator 1 level less than 25%.

(0.5) c) 1 out of 4 high high containment pressure greater than 10 PSIG.

(1.0) d) 3 out of 4 low pressurizer pressure less than 1700 PSIA.

6.2 After extensive operation, gases will tend to accumulate in the steam space of the pressurizer;

(1.0) a) Why will the gases tend to build up in the pressurizer?

(0.5) b) How is gas buildup removed?

6.3 Concerning the emergency diesel system:

(1.0) a) What indications does the operator in the control room have to indicate that the emergency diesel has failed to start on an automatic signal.

(1.5) b) What will cause the emergency diesel to automatically start?

(1.0) c) How many fuel oil storage tanks are there and what is their capacity based on?

6.4 Concerning the safety injection system:

(2.0) a) Sketch a line diagram of the SI system (one train only), for operation during its injection mode. Show and label all major components inside and outside of containment and show flowpath directions.

(1.0) b) Explain how to fill a SIT tank. (You choose one).

6.5 The CPC calculates delta T power.

(1.5) a) What are the input(s) to the CPC that is/are used to calculate delta T power?

(1.5) b) How is the output of the delta T calculator used.

6.6 Concerning the Reactor Power Cutback System; which of the following will not cause a RPC signal to be generated?

a) Lo control oil pressure #2 feedpump.

b) Large load rejection signal initiated by the operator manually.

1.0 c) Secondary pressure biased by average reactor coolant temperature is less than setpoint.

d) Main turbine thrust bearing oil supply pressure low.

6.7 (2.0) a) SCS suction line isolation valves (SI-651, SI-652, SI-655, SI-656) serve to isolate the SCS from the RCS and protect the SCS from over pressure. Explain how this is done (and setpoints).

(1.5) b) When the SCS system is in operation, system components are also protected from overpressure by a relief valve on the suction line (SI-179 and 189). Give the pressure set point and describe the pressure transients for which this valve is designed.

6.8

(0.6) a) Why are the CVCS letdown backpressure control valves needed during operations in Mode 1. (TWO reasons required).

(0.7) b) What would happen to the CVCS system pressure upstream of the letdown backpressure control valve if the valve failed open? EXPLAIN.

(0.7) c) What operator action is required if one of the letdown backpressure control valves failed open.

6.9 Following a main steam line break, the following pressures and levels in S/G 1 and S/G 2 are recorded. For each combination, indicate whether auxiliary feedwater will be provided to S/G 1 and/or to S/G 2. (Assume: low level setpt. = 25%; low pressure setpt. = 729 PSIG; and no operator action was taken)

		Time	S/G 1 W.R. Level	S/G 1 Press	S/G 2 W.R. Level	S/G 2 Press
(.5)	a)	0100	35%	1000	35%	450
(.5)	b)	0105	20%	450	20%	350
(.5)	c)	0110	10%	470	10%	310
(.5)	d)	0115	10%	300	10%	300

For the above, a chart on the answer sheet (like below), and simply indicate YES or No for each S/G. Do not answer on this page.

	S/G 1	S/G 2
a.	______	______
b.	______	______
c.	______	______
d.	______	______

6.10

(1.0) a) After the diesel generator starts on a loss of power (LOP) signal, it will automatically come up to voltage and speed, close the generator breaker and sequence loads. Below are listed 4 major loads. Place them in there order of sequencing.

1) Essential Cooling Water Pumps

2) Containment Spray Pumps

3) Auxiliary Feedwater Pumps

4) Essential Spray Pond Pumps

(1.0) b) Give two of the three diesel protective trips, that are not blocked during emergency mode of operation?

7.0 Procedures-Normal, Abnormal, Emergency and Radiological Control

7.1 Question

Consider operation with known primary to secondary leaks:

(0.5) a) What is the limit on this leakage from a secondary system standpoint?

(0.5) b) What is the basis for this limitation?

(1.0) c) What concerns would operating the turbine driven auxiliary feedwater pump pose? Explain.

7.2 Question

(1.5) a) Describe how the operating personnel can detect a fuel element failure. What instruments might be the first indication?

(0.5) b) Include how they would be able to distinguish it from radioactive corrosion products.

7.3 Question

(3.0) What immediate actions should be taken during an Emergency Plant Shutdown, if reactor excore linear power is not decreasing to source level? Assume you have a reactor trip signal.

7.4 Question

(1.0) Fill in the blank. During Modes 1-4, the time the containment 8-inch purge supply and/or exhaust valve is open to the outside atmosphere is limited to _____ hours for any 365 consectuive days.

7.5 Question

(1.0) a) Give four (4) alarms you would expect to receive on a S/G tube rupture.

(1.0) b) The Steam Generator Tube Rupture procedure holds RCS at a higher pressure than the affected S/G during cooldown and in cold shutdown. Why?

(1.0) c) How would the ruptured steam generator be isolated?

7.6 Question

With the reactor at 100% power and normal operating conditions, it is determined that one of the full length Control Element Assemblies (CEA) in group 5 is immovable, and is misaligned by 20 inches.

(2.0) a) What possible indications and/or alarms would you expect to see? Give four (4).

(1.5) b) What are the immediate actions?

7.7 Question

(2.0) a) Provice the administrative limits for heatup of the RCS.

(1.0) b) Briefly describe the basis for these limits.

7.8 Question

(3.0) In reference to the Reactor Startup procedure (410P-1ZZ03 rev), if the reactor is not critical upon reaching the ECP, what does the operator do next according to the procedure?

7.9 Question

List the most likely source of the following isotopes if found in the RCS.

a. Co^{60}

b. Cs^{137}

(1.5) c. N^{16}

d. A^{41}

e. Fe^{59}

f. I^{131}

7.10 Question

Define the following:

(1.0) a. Radiation Area.

(1.0) b. High Radiation Area.

(1.0) c. Airborne Radioactivity Area.

8.0 Administration Procedures, Conditions and Limitations

8.1 Question

Give the reason(s) for the following limitations and precautions:

(1.5) a) The reactor shall not be made critical if RSC temperature is less than 552°F. Give 2 reasons.

(0.75) b) When shutdown cooling system is in service, do not let RSC pressure exceed 390 psia.

0.75) c) Maximum containment pressure shall be less than 1.5 psig.

8.2 Question

(1.5) List the Reactor Coolant System leakage detection systems that shall be operable in modes 1, 2, 3 and 4.

8.3 Question

(.5) a) How long in a single work period is an operator permitted to work (and meet crew staffing requirements).

(.5) b) How many hours may that person work in a 48-hour period.

(.5) c) How many hours may an operator work in a seven day period.

(.5) d) How many hours shall be provided between work periods.

8.4 Question

The Technical Specification 3/4.2.5 states that "the actual RCS total flow rate shall be greater than or equal to $164.0X10^6$ lbm/hr."

(1.0) a) What administrative requirement(s) and/or system(s) that ensure that this requirement is met.

(1.0) b) What anticipated operational occurence(s) would cause the flow to be outside these limits in Mode 1.

(1.0) c) What safety limits could be violated if operation continued outside these limits.

8.5 Question

(1.0) a) What is the bases for maintaining at least 23 feet of water over the top of the reactor vessel flange during full assembly movement?

(1.5) b) During Core Alterations what status must the containment penetrations be in.

8.6 Question

Midway through an inspection tour in a radiation area, you drop your TLD and pocket dosimeter. The pocket dosimeter is now reading 'off-scale high'. The TLD was damaged and can not be used to determine exposure.

(1.0) a) What are the immediate actions required of you?

(1.0) b) What must be done before you can resume duties inside the Controlled Area?

8.7 Question

During full power operations, a leak develops out of the packing of the pressurizer spray valve.

(1.0) a) What is the allowable leakage from this source? Explain.

(1.0) b) Would isolating the affected spray valve effect pressurizer operability with respect to overpressure control? Explain.

8.8 Question

(3.0) What conditions must be met for the fire suppression system to be operable?

8.9 Quesition

(1.0) When will the Control Room Supervisor enter the "Emergency Operations" procedure?

8.10 Question

(1.5) a) During performance of a procedure you observe that the next step says to start up a system, but you observe that system to already be in operation. What would you do?

(1.5) b) What provisions for temporary changes to procedures is allowed by Technical specifications?

8.11 Question

In your own words, define two (2) of the following:

(2.0) a) Unusual Event -

b) Alert -

c) Site Area Emergency -

d) General Emergency -

MASTER KEY

SECTION 5:

5.1

Answer:

(1.5) a) Exceeding the DNBR limit could reduce heat transfer at the clad surface and lead to localized burnout and failure of the cladding resulting in release of the fission products to the RCS. Exceeding the LHR limit will lead to high centerline fuel temperatures and melting of the fuel. Possible fuel rod rupture could result from resulting high internal pressure. (Burnout) (1.5)

(0.5) b) No, the limits and failure mechanisms are not related. (0.5)

(0.5) c) The trip function setpoints of the Plant Protective Systems (PPS), including the CPC, are selected to ensure that Anticipated Operational Occurances (A00's) which are expected to occur once or more during the life of the plant do not cause the limits for DNBR and LHR to be exceeded.

References:

a) Nuclear Physics, Reactor Theory Notes, Volume IV, Section 4; C-E PWR SYS THERMAL-HYD DESCRIPTION P.7 and P.14-15.

b) PPS system description 3-7.

c) PPS system description; C-E PWR SYS THERMAL-HYD descriptions.

5.2

Answer:

(1.25) a) Subcooling is based on core exit T/C or hot leg RTD readings; during natural circulation, with insufficient bypass flow to the head, the mass of metal in the head can retain heat and keep local temperatures above saturation. The temperature indicators would not reflect this local superheat condition, ~~you have to compare hot leg RTD's with the core exit thermocouples~~. as both would be covered by RCS coolant, unless a massive loss of inventory occurred.

(1.25) b) PZR level decreases because the pressure increase will compress the vessel void and force water out of pressurizer. The level decrease is caused both by hydraulic effects and the subcooling of the head region by the increased pressure.

Reference:

RCS system description; RX vessel and internals systems description; natural circulation requirements-OP-41EP-1ZZ01 Loss of RCS Flow - OP-41RO-1ZZ04.

5.3

Answer:

(1.5) a) A dropped rod will bring the reactor closer to DNB because a dropped rod will reduce the flux in its local area and this will require power to be produced at a higher rate everywhere else in the core and decreasing the DNBR in those fuel elements.

(1.5) b) * As the power drops adjacent to the dropped rod, Xe builds up due to a lower burnout rate around the rod, further pushing the power around the rest of the core. DNBR is lowered further. * allow candidate to end event by assuming CPC penalty factors catchup and within 1 hr will trip the reactor

Reference:

Nuclear physics, reactor theory notes - Volume IV, Section 4, P. 130-140 Thermal and HYD Design - Volume IV, Section 5, P26-40.

5.4

Answer:

(1.0) a) By controlling pH, alkaline conditions are maintained in the feedtrain and the steam generator, and reduce general corrosion in the steam generators at their elevated temperatures. These conditions also promote the formation of a protective metal oxide film and thus reduce the corrosion products released into the S/G.

(1.0) b) Ammonia is added at the discharge headers of the condensate pumps. This volatile amine is added to establish and maintain alkaline conditions in feedtrain and S/G.

(1.0) c) Hydrazine is added to scavenge dissolved oxygen present in the feedwater. Hydrazine also tends to promote the formation of the protective layer on metal surfaces.

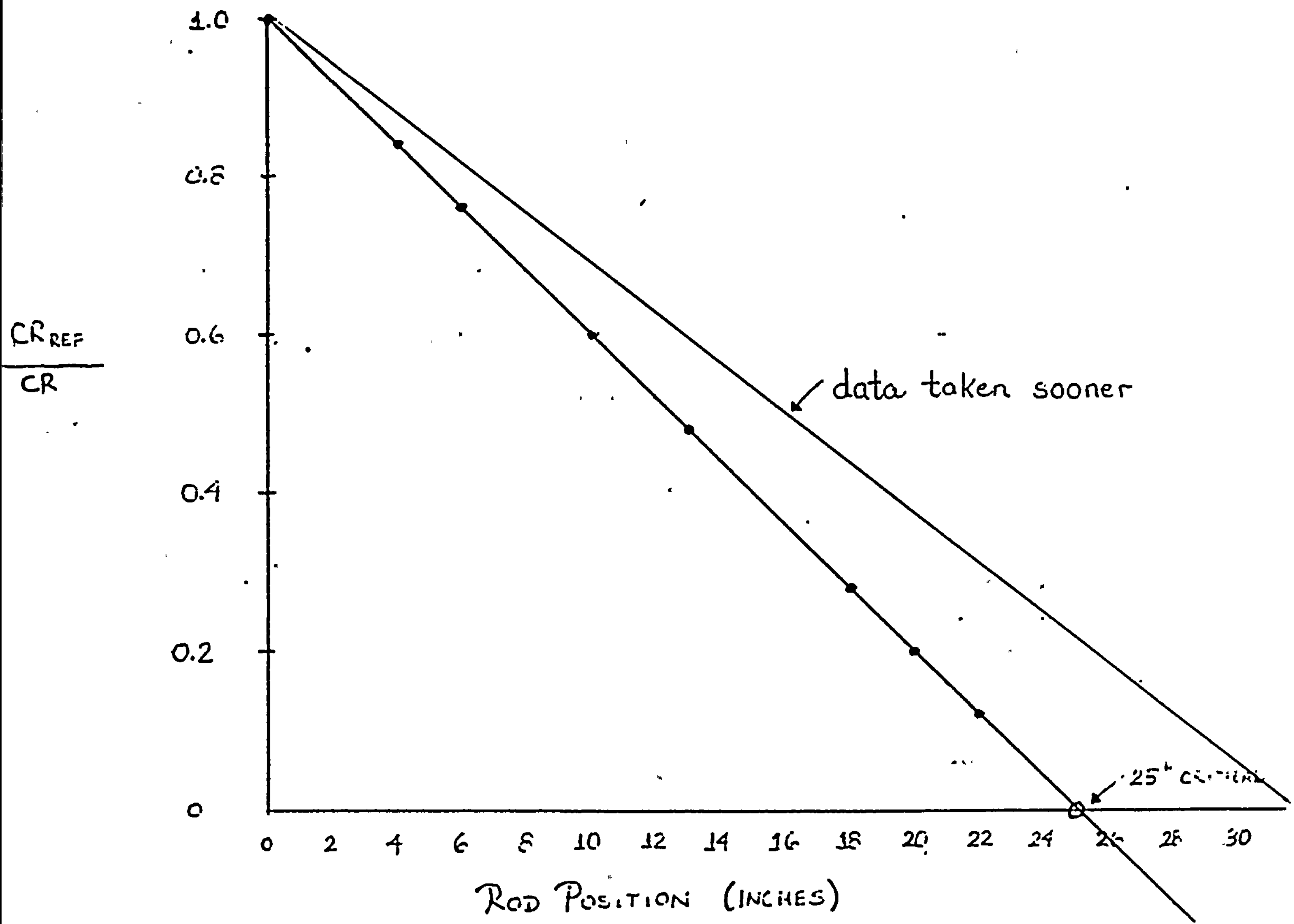
Reference:

NSSS Training Notes - Primary and Secondary Sampling P.25-35.

FIGURE 5.5

5.5 Answer:

(1.0) (a)



(1.0) (b) If data is taken and plotted too quickly, the count rate will not have increased and stabilized. The plot will show criticality won't be reached until substantial additional rod withdrawal is performed. The operator will not see all the growth in count rate which will yield an estimated critical rod height that is higher than actual critical rod height.

Reference:

VOL IV - 4 pp 111-120

5.6

Answer:

(1.0) a) Change in core reactivity per degree change in moderator temperature.

(2 reasons)b) Mod. Temp increases; therefore, mod. density decreases
1.0 each) resulting in:

1) increase in neutron leakage;

or 2) increase in resonance absorptions (U-238, Pu-240);

or 3) increase in poison and control rod absorptions;

or 4) decrease in boron atoms in the core therefore less boron absorptions.

(0.5) c) * Fission products are neutron absorbers which buildup faster in the high flux areas. This building forces flux radially outward (both in the fuel rod and the core). The displaced flux increases boundary leakage (buckling); this causes a greater increase in leakage per degree change in moderator temperature.

Reference:

Nuclear Physics, Reactor Theory Notes - Volume IV-4, PP. 124-127.

* also consider explaination of c using 4 factor formular + buildup of Pu 240.

5.7

Answer:

(1.0) a) Xenon:

Production	. Iodine decay (fission daughter) . directly from fission
Removal	. burnout by neutron absorption . decay

(1.0) b) Samarium:

Production	. Promethium decay (fission daughter) . directly from fission
Removal	. Burnout by neutron absorption

(1.0) c) Xenon production and removal by burnout are power (flux) dependent while removal by decay is independent of flux level. Thus, to keep a balance between production and removal (equilibrium) the amount of Xenon must increase with power to increase the decay rate to match the higher production rates.

Samarium production and removal are all power dependent since Samarium is stable and has no decay term. Thus, at any power the production and removal rates remain equal without changing the amount of samarium present.

Reference:

Nuclear Physics, Reactor Theory Notes - Volume IV-4, pp. 138-142.

5.8

Answer:

(2.0) a) With an open MSR safety valve steam would be vented to the atmosphere reducing the HP backpressure (feeds to T_{ref}), (0.5), and drawing more steam from the S/G (0.5). The S/G steam flow increase will cause T_c to drop, resulting in Tave to drop (0.5). Tave-Tref difference will cause the RRS system to request the rods to be withdrawn (0.5).

Reference:

NSSS Lecture - Reactor Regulating System, pp. 9-12.

5.9

Answer:

(1.0) Primary coolant is kept subcooled while secondary coolant is allowed to boil. The heat required to boil a pound of water accounts for the flow-rate difference. The secondary enthalpy rise is ten times the primary enthalpy rise.

Reference:

Chapter 11, "Nuclear Heat Transport" - EL WAKIL

5.10

Answer:

(0.5) a) A

(0.5) b) Both critical at same height

(0.5) c) B

(1.0) d) A lower reactivity addition rate will allow a greater amount of delayed neutrons to enter fission chain process. The effects of subcritical multiplication will yield a higher equilibrium power level for the lower reactivity addition rate.

Reference:

Volume IV - 4 pp. 111-120.

SECTION 6: - KEY

6.1

Answer:

(1.5) a) Containment isolation signal (CIAS) and Main Steam Isolation Signal (MSIS) and Safety Injection Actuation Signal (SIAS).

(0.5) b) Auxiliary Feedwater Actuation signal-1 (AFAS-1).

(0.5) c) None.

(1.0) d) CIAS and SIAS.

Reference:

Volume VI-4 and sample SRO test

6.2

Answer:

(1.0) a) In the pressurizer, gases tend to come out of (solution) due to the spray and the higher temperature existing in the pressurizer. The solubility of gases in water decreases as temperature increases. Spray flow tends to agitate the spray water and liberate the dissolved gases in the pressurizer.

(0.5) b) The pressurizer steam space can be vented or degrassed through the purge path provided by the pressurizer steam space sample connector to either the volume control tank or the chemical and volume control recycle drain header.

Reference:

NSSS lecture Primary Sampling System
System Description RC-7

6.3

Answer:

(1.0) a) i) Incomplete sequence alarm.

ii) Lack of DG running alarm.

iii) Lack of voltage or speed indication.

(0.5) b) i) Safety injection actuation signal (SIAS).

ii) Auxiliary feedwater actuation signal (AFAS).

iii) Loss of voltage to its respective bus (LOP).

(1.0) c) Two-one for each diesel (0.5) capacity is based on providing sufficient storage of the diesel fuel oil for 7 days continuous operation (0.5) - plus 15% margin for testing.

Reference:

Volume IV-1 Diesel Descrption

6.4

Answer:

(2.0) a) See figure 1-E. (SI-V463)

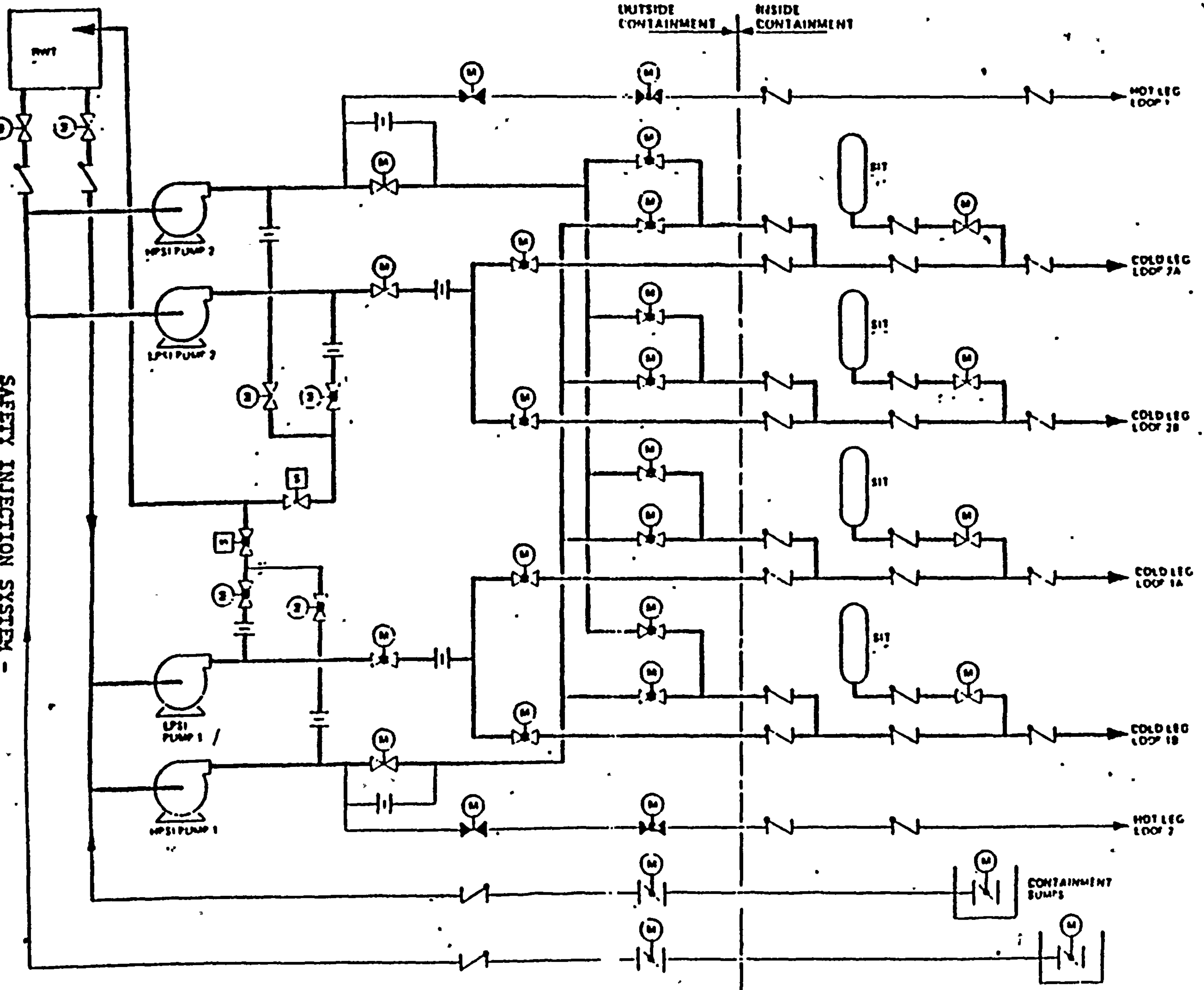
(1.0) b) Perform valve lineup-open SIT fill and drain line CI valve open SIT fill and drain isolation valve (SI-V400) using HPSI pump recirc line/misc. drain to RWT.

Reference:

Sample SRO exam (Vol XV) and 41OP-1SI02

6.4 ANSWER

a)



SAFETY INJECTION SYSTEM -
INJECTION MODE

FIGURE 1-E

6.5

Answers:

(1.5) a) PZR pressure
Calc. RCS flow (RCP speed sensor).
T hot
T cold

(1.5) b) The highest of delta power and calib. neutron flux power is used in the DNBR and local power density algorithms.

Reference:

CPC Functional Block Diagram, Figure 31, RSP and CPC disciption. (P.ds.-18-20)

6.6

Answers:

(1.0) Response d. will cause turbine trip not RPC.

Reference:

NSSS lecture notes - RPCS Volume VII-4.

6.7

Answer:

(2.0) a) These motor operated valves have interlocks in their control circuit that prevent the valves from being opened if RCS pressure is greater than 370 ~~400~~ PSIA (25). These interlocks will also close the valves if pressure increases to ~~500~~ PSIA (.25).
SI651 700#
SI652 450#

(1.5) b) Set point is 417 ±5 (.25) and protects system from overpressure due to inadvertent operation of PZR heaters, HPSI or charging pumps.

Reference:

NSSS Lecture SCS Page 38, Volume VI-4.

6.8

Answer:

(0.6) a) Protect downstream purification equipment from overpressurization (0.3). Prevent upstream letdown flow from flashing to steam (0.3).

(0.7) b) Pressure would remain constant for a short time because the letdown accumulator would discharge to limit depressurization. (0.3) System will depressurize. (0.4)

(0.7) c) Operator will isolate the failed valve and place other letdown backpressure control valve in service.

Reference:

Chemical and Volume Control System L. P. pg 14-17; Volume VI-2.

6.9

Answer:

	S/G 1	S/G 2	
(.5) a)	No	No	
(.5) b)	Yes	~~No~~ YES	
(.5) c)	Yes	~~No~~ YES	S/G dP has been chg'd to 186
(.5) d)	~~No~~ YES	~~No~~ YES	us block of S/G low Pressure

Reference:

AFW System Description Section 3 and 4, Volume III-7.

6.10

Answer: Part a)

(0.5) 1) Auxilary Feedwater Pumps (10 sec)

(0.5) 2) Containment Spray Pumps (15 sec)

(0.5) 3) Essential Cooling Water Pumps (20 sec)

4) Essential Spray Pond Pumps (25 sec)

Part b) 2 of 3 - GENERATOR differential.
- Low engine lube oil pressure.
- Overspeed.

Reference:

(0.5 ea) Diesel Generator Handbook , P. 10, 25, 50; Volume IV-1.

SECTION 7:

7.1 Answer:

(0.5) a) * 1 GPM total primary-to-secondary through both S/G's. 720 gallons per day through any one S/G.

(0.5) b) 10 CFR 100 limits with a steam line break.

(1.0) c) Turbine driven AFP relieves to atmosphere (you would have to get main steam line monitor readings - proportion flow and calculate release rate.) The exhaust is unmonitored.

* give full credit for S/G activity > .1 uc/ml

Reference:

a) TS 3.4.5.2

b) TS BASES 3/4.4.5.2

c) FSAR and P&ID's; Volume III-6-(11-6); Volume IV-2.

7.2 Answer:

(1.5) a) An increase in the activity of the RCS would be an indication of a fuel rod leaking. (1.0) The letdown process radiation monitor in the CVCS would be the first indication of this. (0.5)

(0.5) b) Draw a sample and measure I-131/I-133 ratio. This will confirm fuel element failure.

Reference:

CVCS description volume VI-2; T.S. 3/4.4.7 and bases.

7.3 Answer:

1) Manually trip reactor, ~~and~~ 2) ensure all CEA's are inserted.

(0.75 each) ~~2) Manually initiate EFAS #1 and EFAS #2.~~

3) Initiate Emergency Boration.

4) Manually insert all CEA's if not already tripped ~~trip the turbine, if not already tripped.~~ (procedure chg'd)

Reference:

Emergency operations; 41EP-1ZZ01

7.4 Answer:

(1.0) 1,000 (±200) hours

Reference:

TS 3.6.1.7

7.5 Answer:

(Any 4 .25 each) a) S/G blowdown Rad Monitor-Hi, Condenser Air Ejector Airborn Rad-Hi; Main Steam Line Radiation-Hi, PZR Pressure-LO, VCT level Hi/Lo; PZR Pres level Error-Lo; or High Range Air Ejector Vent Monitor.

(1.0) b) Making RCS pressure higher than S/G pressure ensures RCS dilution does not occur, thereby not compromising the shutdown margin.

c)* 1. Close the atmospheric dump on the affected S/G.

2. Ensure blowdown is isolated.

(~~.25~~ .2 ea) 3. Close MSIV and MSIV bypass valve on the affected S/G.

4. Ensure feed isolation valves are shut to the affected S/G (Economizer and ~~blowdown).~~ DOWNCOMER).

5. ISOLATE AUX FEED STEAM SUPPLY FROM AFFECTED S/G

Reference:

41RO-1ZZ06 and 41EP-1ZZ01 App. T&U Steam Generator Tube Rupture. (cautions)

c)* also a correct responce would be to manually initiate MSIS for affected S/G

7.6 Answer:

(Any 4 0.5 each)

a) 1) UEL light goes out.

MAJOR

2) Group deviation alarm.

9. MINOR " " "

3) CEA deviation alarm on CEAC.

4) Temp (Avg)/Temp (Ref) Lo alarm.

5) Prepower dependent insertion limit.

6) Power dependent insertion.

7) DNBR Lo RPS Channel Pre-trips.

8) COLSS i) Power margin on PMS.

ii) Azimuthal Tilt Alarm on PMS.

b) 1) Place the CEDMDS in manual sequential mode and verify CEA is misaligned.

(1.5) 2) Reduce Turbine-Generator load to match Tavg and Tref.

3) DETERMINE THAT ~~If COLSS is in service, then ensure~~ a (+) shutdown margin EXISTS, ~~on Power Margin Limit indicator.~~

Reference:

41A0-1ZZ10-Immovable CEA.

7.7 Answer:

a) 95 Tc < ~~100~~ 95 °F — 20°F/hr
~~100~~ °F < Tc < ~~345°F~~ 400°F — 40°F/hr
(2.0) ~~345°F A Tc < 390°F — 85°F/hr~~
greater than ~~390°F~~ 400°F — 100°F/hr

Chg'd

(1.0) b) Credit will be given for discussion of brittle fracture, sensitive components, cyclic operations and shift in RT NDT due to irradiation and temperature shift.

Reference

T.S. 3/4.4.8 and bases figure 3.4-2 and 3.4-3.

7.8 Answer

(3.0) If the reactor is not critical upon reaching the ECP, the operator will fill out a chart given in the procedure and will withdraw regulating groups in 100 PCM increments until the reactor is critical or ECP + 500 PCM is reached. (1.0)

Reference:

410P-1ZZ03, paragraph 4.3.10.1, 4.3.10.2

7.9 Answer

a. Co^{60} - Activated corrosion product.

b. CS^{137} - Fission product.

(0.25 ea) c. N^{16} - From activation of 0^{16}.

d. A^{41} - From activation of air in RCS.

e. Fe^{59} - Activated corrosion product.

f. I^{131} - Fission product.

Reference:

Nuclear Physics and Reactor Theory Notes and "Nuclear Physics" - I. Kaplan.

7.10 Answer

(1.0) a. Radiation Area - Any area accessible to personnel in which there exists radiation, originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 mrem, or in any 5 consecutive days a dose in excess of 100 mrem.

(1.0) b. High Radiation Area - Any area accessible to personnel in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could recieve in any one hour a dose in excess of 100 mrem.

(1.0) c. Airborne Radioactivity Area - Any room, enclosure, or operating area in which airborne radioactive materials composed wholly or partly of licensed material, exist in concentration in excess of the amounts specified in Appendix B Table 1 Column 1 of 10 CFR 20 or any room, enclosure or operating area where concentrations exist which, average over the number of hours in any week during which individuals are in the area exceed 25% of the amounts specified in Appendix B Table 1 Column 1 of 10 CFR 20.

Reference:

Exam Bank.

SECTION 8:

8.1 Answers:

Full credit for Any 2 0.75 each)	a1)	Ensures modulator temperature coefficient is within its analyzed temperature range.
	a2)	The protective instrumentation is within its normal operating range.
	a3)	To ensure consistency with the FSAR safety analysis.
	a4)	The reactor vessel is above its minimum RT_{NDT} temperature.
(0.75)	b)	Overpressure protection of SDCS components.
(0.75)	c)	Ensures that containment peak pressure does not exceed design pressure of 60PSIG during events analyzed in the FSAR.

References:

a) TS Bases 3/4.1.1.4

b) 410P - 1STI01 and

c) TS Bases 3/4.6.1.4.

8.2 Answer:

(0.5) a) A contamination atmosphere particulate radioactivity monitoring system.

(0.5) b) The containment sump level and flow monitoring system.

(0.5) c) The containment atmosphere gaseous radioactivity monitoring system.

Reference:

T.S. 3/4.4.5

8.3 Answer:

(0.5) a) 16 hours straight in any 24 hour period.

(0.5) b) 24 hours.

(0.5) c) 72 hours.

(0.5) d) 8 hours.

Reference:

40AC-9ZZ02

8.4 **Answer:**

(1.0) a) Surveillance requirement once per 12 hours in mode 1. Reactor coolant flow-low trip in RPS.

(1.0) b) RCP sheared shaft and two pump opposite loop flow coastdown event.
or Low Flow due to simultaneous loss of electrical to all RCP at 100% Power

(1.0) c) DNBR, LPD.

Reference:

T.S. 3/4.2.5; CESAR and Volume IV-5-VI Applications of Thermal Hydralic Design; RCS System Description Volume VI-1.

8.5 **Answer:**

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

(1.5) b) i) The equipment door closed and held in place by a minimum of 4 bolts.

ii) A minimum of one door in each air lock is closed, and

iii) Each penetration providing direct access from the containment atmosphere to the outside atmosphere shall be either:

1. Closed by an isolation valve, blind flange or manual valve, or

2. Be capable of being closed by an operable automatic containment purge valve.

Reference

a) T.S. 3/4.9.10

b) T.S. 3/4.9.4 Containment building Penetrations

8.6 Answer:

(1.0) a) Immediately proceed to exit point and report to Radiation Protection Section.

(1.0) b) Make an estimate of exposure based on surveys of tour route and check exposure of other workers who made similar tours.

If a reasonable estimate cannot be made. Limit exposure to 100 mrem for the quarter.

Reference:

CAF and 75AC-9ZZ01 and APPX A of 75RP-9ZZ12.

8.7 Answer:

(1.0) a) Not a pressure boundary leakage; 1 GPM unidentified; 10 GPM identified.(operator must state in assumption of unident or ident.)

(1.0) b) No, safety valves only overpressure requirement, and alternate spray is available.

Reference:

TS 3.4.5.2 and TS 3.4.2.1-3.

8.8 Answer:

(3.0) Three (50% capacity) fire suppression pumps, with their discharge aligned to the fire suppression header.(1.0) Two separate water supply tanks. Each with a minimum volume (of 300,000 gals), (1.0) and an operable flow path from the tanks to all fire suppression equipment supplied, i.e., hydrants, hose stations, sprinkler headers, deluge valves.(1.0)

Reference:

TS 3/4.7.11

8.9 Answer:

The "Emergency Operations" procedure will be used following a major event. A major event is any automatically activated plant protective signal. It is also required whenever the reactor is
(1.0) tripped for reasons other than normal procedure shutdown.

The procedure may also be used at the discrection of the Control Room Supervisor, if he feels tripping the reactor is warranted.

Reference:

41EP-1ZZ01-1.0 Control Room Supervisors Actions

8.10 Answer:

(1.5) a. It depends upon the procedure and the initial conditions. Some procedures are written with SRO discretion to bypass such steps, but other procedures require exact step by step adherence. Operator should read the precautions, limitations and initial conditions.

(1.5) b. May be made if:

- Original intent is not changed.
- Approved by two members of Plant Management staff, at least one who is SRO.
- Documented, reviewed by PRB, approved by Manager of Nuclear Operations or designee within 14 days.

Reference:

40AC-9ZZ02, Section 5.7 - Use of Procedures and 70AC-0ZZ02 Review and Approval of Station Procedures.

8.11 Answer:

2 of the 4 (1.0 ea)

a. Notification of Unusual Event - An occurrence which might result in a decreased level of safety at the plant. Occurrences of this type will not result in a release of radioactive materials requiring offsite notification unless a further degradation of safety systems requiring a higher classification occurs.

b. Alert - An occurrence which involves either an actual minor degradation or a potential substantial degradation of the plant safety level. If a radioactive release occurs, it is not expected to exceed a small fraction of the Environmental Protection Agency Protective Action Guidelines.

c. Site Area Emergency - Major damage has occurred or is likely to occur to plant functions needed for the protection of the public. Environmental Protection Agency Protective Action Guidelines exposure levels are not expected to be exceeded except near the site boundary.

d. General Emergency - Substantial core degradation with a potential for loss of containment integrity has occurred or is imminent. Radioactive releases in excess of the Environmental Portection Agency Protective Action Guidelines are expected outside of the immediate site area.

Reference:

EPIP-02 Emergency Classification..

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: PALO VERDE 1

REACTOR TYPE: CE-PWR

DATE ADMINISTERED: 84/03/20

EXAMINER: WHITTEMORE, J.

APPLICANT: ____________________

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(POST PLANT REVIEW)

INSTRUCTIONS TO APPLICANT:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category and a final grade of at least 80%. Examination papers will be picked up six (6) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	APPLICANT'S SCORE	% OF CATEGORY VALUE	CATEGORY
25.00	25.19	________	________	1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.19	________	________	2. PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
24.25	24.43	________	________	3. INSTRUMENTS AND CONTROLS
25.00	25.19	________	________	4. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
99.25	100.00	________	________	TOTALS

FINAL GRADE ________________%

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

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REGION V

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QUESTION 1.01 (2.00)

If while operating at 50% power, a rod located toward the middle of the core (rod 20) drops. What effect will this dropped rod have on:

a. Local Radial Flux distribution?

b. Local Axial Flux distribution? (2.0)

QUESTION 1.02 (4.00)

If your reactor is critical at 10 -4%, no load Tave is being maintained by steam dumps and all RCP's operating; DESCRIBE the plant RESPONSE if the steam dump setting were increased by approximately 40 psig under the following conditions; (assume no operator action) (answer each one SEPERATELY with normal plant conditions and assume all other coefficients to be typical MOL values).

a. Value for MTC is zero

b. Value for MTC is slightly positive (MTC= +.5 PCM)

c. Value for Doppler Coefficient is zero (4.0)

QUESTION 1.03 (3.00)

How can an INCREASE in each of the following plant parameters affect the departure from nucleate boiling ratio (DNBR)? Answer with INCREASE, DECREASE, or NO AFFECT AND a very brief explanation. (Assume all other parameters are held constant).

a. Reactor Power

b. Primary Coolant flow rate

c. Inlet temperature (Tc)

d. Pressurizer Pressure (3.0)

QUESTION 1.04 (2.00)

a. Following a xenon free startup, why must the RCS boron concentration be reduced at a higher rate after 10 hrs. compared to 60 hrs. following the starup? (assume constant 100% power and constant rod height) (1.0)

b. Indicate whether the reactor coolant system PPM boron concentration INCREASES, DECREASES or REMAINS THE SAME with an increase in RCS temperature during normal at power conditions. EXPLAIN your answer. (Consider temperature change only). (1.0)

QUESTION 1.05 (2.00)

Indicate on your answer sheet whether the following statements are TRUE or FALSE. (No explanation is required).

a. If a given centrifugal pump speed is increased, the greater the NPSH required to prevent cavitation.

b. One of the pump laws for centrifugal pumps states that the volume flowrate is inversly proportional to the speed of the pump.

c. Shutoff head is the term used to describe the condition of a centrifugal pump running with no volume flow rate.

d. The area of a centrifugal pump volute is increasing in the direction of flow and in order to maintain a constant flowrate the velocity must increase. (2.0)

QUESTION 1.06 (2.50)

The ratios of the PU 239 and PU 240 atoms to U 235 atoms increase over core life. EXPLAIN the effect these ratios have on the following.

a. Delayed Neutron Fraction (1.0)

b. Reactor Period (1.0)

NO EXPLANATION IS REQUIRED FOR PART C BELOW!

c. Does the Doppler Temperature Coefficient become more or less negative? (0.5)

QUESTION 1.07 (1.00)

TRUE or FALSE?

a. When reactor power is constant (below the point of adding heat), reactor period is slightly positive to overcome heat losses. (0.50)

b. Reactor period is longer at EOL than at BOL, for the same reactivity insertion. (0.50)

QUESTION 1.08 (1.50)

Beta is the fraction of all neutrons released by fission which are delayed:

a. From BOL to EOL, does the AVERAGE delayed neutron fraction increase, decrease, or remain the same? (0.5)

b. In a CE-PWR, why is Beta eff. less than Beta? (0.5)

c. For equivalent positive reactivity addtions to a critical reactor, will the SUR be larger or smaller at EOL compared to BOL? (0.5)

QUESTION 1.09 (3.00)

a. Why must the primary system flowrate be approximately 10 times greater than secondary system flowrate? (1.5)

b. Why is a primary heat balance considered less accurate than a secondary heat balance? (1.5)

QUESTION 1.10 (2.00)

Assume that your plant has experienced a degraded power condition and that you are monitoring the plant's cooldown on natural circulation. Explain whether and why you agree or disagree with the following statements:

a. A slow downward trend in indicated Tave is a good indication of well-established natural circulation flow. (1.0)

b. A difference between wide-range Th and wide-range Tc of 65°F and slowly increasing, indicates developing natural circulation flow. (1.0)

QUESTION 1.11 (2.00)

Explain why you agree or disagree with each of the following statements:

A. Equilibrium Xenon at 100% power is about twice as much as equilibrium Xenon at 50% power. (1.0)

B. Equilibrium Samarium at 100% power is about twice as much as equilibrium Samarium at 50% power. (1.0)

QUESTION 2.01 (3.00)

a. Describe the automatic positioning of the steam generator feedwater regulating valve to the downcomer during a power level increase from 0% to 100% power. EXPLAIN why the valve position is programmed in this manner. (1.5)

b. Following a reactor trip from 100% power how will the feed pumps and feed regulating valves control steam generator water level? (Assume all systems in automatic). (1.5)

QUESTION 2.02 (1.00)

What system design feature ensures the MSIV's can be closed following a loss of off-site power and Instrument and Service air system? Explain. (1.0)

QUESTION 2.03 (3.00)

Sketch a one line diagram of the auxiliary feedwater system from the source(s) of water to the steam generators. Include pumps, major control valves, and interfaces with other plant systems. INDICATE which valves and pumps would be actuated on an auxiliary feed actuation signal (AFAS). (3.0)

QUESTION 2.04 (1.75)

a. After a complete loss of normal AC power, what provides flow through the core during;

1. Short term? (first three minutes) (0.50)

2. Long term? (next three minutes to ten hours) (0.50)

b. How does the design of the RCS enhance long term cooling? (0.75)

QUESTION 2.05 (3.25)

a. What three signals will automatically start the Diesel Generator? (0.75)

b. What TWO TYPES of governor control are used on the Diesel Generators? Explain briefly which type is preferred for normal operations and why? (1.75)

c. What THREE diesel protective trips are not blocked during emergency mode operation? (0.75)

QUESTION 2.06 (3.00)

After extensive operation, gasses will tend to accumulate in the steam space of the pressurizer;

a. Why will the gasses tend to build up in the pressurizer? (1.5)

b. How will excess gas in the vapor space of the pressurizer be removed? (1.5)

QUESTION 2.07 (3.00)

The following concerns the control rod drive system:

a. The following concern failure of a CEA lift coil with the rod fully withdrawn;

1. Explain why the rod WILL or WILL NOT drop.

2. Explain why the rod WILL or WILL NOT move on a demand signal. (1.5)

b. What means exist to determine whether a control rod is withdrawing properly? (Five SEPERATE sytems indications required) (1.5)

QUESTION 2.08 (1.50)

a. Two fuel pool cooling pumps and two heat exchangers are required for cooling the fuel pool when 13 one-third cores are stored. What cooling changes are required when a total core is moved to the pool? (1.0)

b. What system is used to cool the fuel pool when the nuclear cooling water system is not avalaible? (0.5)

QUESTION 2.09 (3.00)

a. What THREE conditions will cause a heater drain pump to trip, other than manual? (1.5)

b. You observe excessive steam condensation venting from the blowdown stack outlet. What THREE conditions could cause this to happen? (1.5)

QUESTION 2.10 (2.50)

a. Explain how the shutdown cooling system is protected from overpressurization. (Disregard any relief valves in the SDC system) (1.5)

b. How do you determine what ACTUAL shutdown cooling loop pressure is when shutdown cooling is operating? (1.0)

QUESTION 3.01 (4.00)

Two plant protection system trips, High Local Power Density and Low DNBR, are generated by the Core Protection Calculators.

a. What is the purpose of each of these trips? (1.5)

b. List 6 inputs to the core protection calculator which are used to generate these trips. (1.8)

c. What control action takes place when the pre-trip setpoints are reached? (0.7)

QUESTION 3.02 (3.75)

Will the following changes cause the core protection calculator (CPC) values for the Departure from Nucleate Boiling Ratio (DNBR) and the Local Power Density (LPD) to be:

1. Closer to a trip set point
2. Further from a trip set point
3. Greater than a trip set point
4. Unchanged

Briefly explain each answer.

a. Both CEA position computers fail. (1.25)

b. Speed indication of a RCP is lost. (1.25)

c. Axial Shape Index (ASI) decreases from +0.4 to +0.2. (1.25)

QUESTION 3.03 (2.00)

Assume plant operations at 60% power with CEDMCS in the Auto Sequential mode. Loop 1B Tc instrument fails open and Tave is selected to average. Explain what happens to the Reactor Regulating system and WHY. (2.0)

QUESTION 3.04 (3.00)

How would the following indications be affected (INCREASE , DECREASE or NO CHANGE) by the associated condition change listed below? Consider each indication separately and EXPLAIN your answer.

INDICATION	CONDITION CHANGE	
a. Nuclear Wide Range Instrument	Cold leg temperature increases 50 degrees F at constant true nuclear power	(1.0)
b. Pressurizer level	Differential pressure transmitter reference leg temperature increases 10 degrees F.	(1.0)
c. Steam Generator level	Control steam flow signal increases (no change in actual steam flow)	(1.0)

QUESTION 3.05 (2.80)

a. With the CEA control system in automatic sequential (AS), how can power be reduced from 100% to 80% without producing CEA motion? (0.8)

b. What inputs and calculations are used in the Reactor Regulating System (RRS) to produce a CEA motion demand signal. (2.0)

QUESTION 3.06 (2.70)

a. What signals will give an automatic reactor power cutback signal? (Two required) (1.2)

b. Explain what plant conditions are required before a turbine runback will occur following a reactor power cutback. (1.5)

QUESTION 3.07 (1.50)

Under what TWO conditions will the SBCS block the quick-opening of the Turbine Bypass valves? (1.5)

QUESTION 3.08 (1.50)

Describe what happens in the Feedwater control system upon receiving a reactor tripped override (RTO) signal. Include any additional control signals the system receives. (1.5)

QUESTION 3.09 (3.00)

Match the following indications/parameters you would use to differentiate between the two accidents within each group. (Assume steady state 70% reactor power).

1. Small LOCA outside containment AND S/G tube rupture (3 required)

2. Small LOCA inside containment AND feedwater break inside containment upstream check valve (7 required)

3. Steam break outside containment AND small LOCA outside containment (5 required)

a. Tave
b. RCS pressure
c. Przr. level
d. VCT level
e. Containment: pressure, temperature, humidity
f. Containment airborne
g. steam flow
h. steam pressure
i. feedwater flow
j. S/G level
k. Air ejector/S/G blowdown activity (3.0)

QUESTION 4.01 (2.75)

The plant is at 90% power in steady state conditions, except a xenon ocsillation, resulting from a previous power transient, is in progress.

a. If the COLSS is inoperable, what indications would alert the operator to the presence of the xenon oscillation? (0.75)

b. What TWO advantages would the COLSS provide if it was operating? (1.0)

c. What actions should be taken if ASI varies by more than 0.05 units from ESI? (1.0)

QUESTION 4.02 (2.80)

If a reactor trip AND safety injection occurred as a result of a steam generator tube rupture:

a. What are FOUR ways the ruptured steam generator could be identified? (1.6)

b. How would the ruptured steam generator be isolated? (1.2)

QUESTION 4.03 (2.00)

a. If equal RADS of alpha, beta and gamma were injested by swallowing, which would cause the highest dose? EXPLAIN. (1.0)

b. Which of the above would present the greatest EXTERNAL radiation dose? EXPLAIN. (Your are wearing protective clothing and safety glasses only). (1.0)

QUESTION 4.04 (1.25)

Explain the probable cause AND the corrective action for an increasing VCT level following isolation of the CVCS charging and ledown system. (Letdown valves CH-LV-110P and CH-LV-110Q shut; charging pumps secured). (1.25)

QUESTION 4.05 (2.00)

Indicate whether each of the following items DOES or DOES NOT have a associated Technical Specifications limit.

a. Reactor Regulating System
b. Turbine Generator Overspeed Trip System
c. Steam Generator Safety Valves
d. Main Feed Pump
e. Fire Detection System (2.0)

QUESTION 4.06 (3.00)

a. During a SG tube rupture, why must the hot leg temperature be less than 571 F prior to isolating the affected SG? (0.5)

b. What actions should be taken to cooldown the RCS following a SG tube rupture if the MSIV for the affected SG fails to shut? (Assume below 535 F) (1.0)

c. During a SG tube rupture, how should the affected SG water water level be controlled, if the affected SG is isolated, the blowdown system is unavailable, and the following indications are present: (1.5)

PZR pressure = 1300 psia
RCS hot leg temperature = 545 F
Affected SG pressure = 900 psia

QUESTION 4.07 (1.50)

Palo Verde emergency procedure 41RO-1ZZ04 (Loss of RCS Flow), gives THREE indications/conditions which indicate a loss of flow. What are these THREE indications/conditions? (1.5)

QUESTION 4.08 (3.20)

If after operating in natural circulation for 2 hours, operator error causes a large reduction in natural circulation flow, how will the following parameters change (INCREASE, DECREASE, or REMAIN THE SAME)? Briefly explain your answer. (Assume no further operator action.)

a. Delta T across the core

b. Core thermocouple temperature

c. Steam generator pressure

d. Steam generator level (3.2)

QUESTION 4.09 (2.10)

As defined in the Station Tagging and Clearance procedure (40AC-0ZZ05) when would you use the following tags?

a. Red Tag

b. Yellow Tag

c. Blue Tag (2.1)

QUESTION 4.10 (2.00)

In the Purification sytem procedure, "Placing a purification ion exchanger in service", there is a sentence that states: "Instruct the nuclear operator to open 2 turns the ion exchanger outlet valve." Why shouldn't the nuclear operator open the outlet valve to the full open postion? (2.0)

QUESTION 4.11 (2.40)

According to the Emergency Operations Diagnostic Procedure (41EP-1ZZ01), what reports will the following operators make to the Control Room Supervisor (CRS)?

a. Primary operator (four required) (1.2)

b. Secondary operator (four required) (1.2)

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: PALO VERDE 1

REACTOR TYPE: CE-PWR

DATE ADMINISTERED: 84/03/20

EXAMINER: WHITTEMORE, J.

APPLICANT: ____________

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(POST PLANT REVIEW)

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25.00	25.19			1.	PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	25.19			2.	PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS
24.25	24.43			3.	INSTRUMENTS AND CONTROLS
25.00	25.19			4.	PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
99.25	100.00				TOTALS

FINAL GRADE ____________%

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

____
APPLICANT'S SIGNATURE

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QUESTION 1.01 (2.00)

If while operating at 50% power, a rod located toward the middle of the core (rod 20) drops. What effect will this dropped rod have on:

a. Local Radial Flux distribution?

b. Local Axial Flux distribution? (2.0)

QUESTION 1.02 (4.00)

If your reactor is critical at 10 -4%, no load Tave is being maintained by steam dumps and all RCP's operating; DESCRIBE the plant RESPONSE if the steam dump setting were increased by approximately 40 psig under the following conditions; (assume no operator action) (answer each one SEPERATELY with normal plant conditions and assume all other coefficients to be typical MOL values).

a. Value for MTC is zero

b. Value for MTC is slightly positive (MTC= +.5 PCM)

c. Value for Doppler Coefficient is zero (4.0)

QUESTION 1.03 (3.00)

How can an INCREASE in each of the following plant parameters affect the departure from nucleate boiling ratio (DNBR)? Answer with INCREASE, DECREASE, or NO AFFECT AND a very brief explanation. (Assume all other parameters are held constant).

a. Reactor Power

b. Primary Coolant flow rate

c. Inlet temperature (Tc)

d. Pressurizer Pressure (3.0)

QUESTION 1.04 (2.00)

a. Following a xenon free startup, why must the RCS boron concentration be reduced at a higher rate after 10 hrs. compared to 60 hrs. following the starup? (assume constant 100% power and constant rod height) (1.0)

b. Indicate whether the reactor coolant system PPM boron concentration INCREASES, DECREASES or REMAINS THE SAME with an increase in RCS temperature during normal at power conditions. EXPLAIN your answer. (Consider temperature change only). (1.0)

QUESTION 1.05 (2.00)

Indicate on your answer sheet whether the following statements are TRUE or FALSE. (No explanation is required).

a. If a given centrifugal pump speed is increased, the greater the NPSH required to prevent cavitation.

b. One of the pump laws for centrifugal pumps states that the volume flowrate is inversly proportional to the speed of the pump.

c. Shutoff head is the term used to describe the condition of a centrifugal pump running with no volume flow rate.

d. The area of a centrifugal pump volute is increasing in the direction of flow and in order to maintain a constant flowrate the velocity must increase. (2.0)

QUESTION 1.06 (2.50)

The ratios of the PU 239 and PU 240 atoms to U 235 atoms increase over core life. EXPLAIN the effect these ratios have on the following.

a. Delayed Neutron Fraction (1.0)

b. Reactor Period (1.0)

NO EXPLANATION IS REQUIRED FOR PART C BELOW!

c. Does the Doppler Temperature Coefficient become more or less negative? (0.5)

QUESTION 1.07 (1.00)

TRUE or FALSE?

a. When reactor power is constant (below the point of adding heat), reactor period is slightly positive to overcome heat losses. (0.50)

b. Reactor period is longer at EOL than at BOL, for the same reactivity insertion. (0.50)

QUESTION 1.08 (1.50)

Beta is the fraction of all neutrons released by fission which are delayed:

a. From BOL to EOL, does the AVERAGE delayed neutron fraction increase, decrease, or remain the same? (0.5)

b. In a CE-PWR, why is Beta eff. less than Beta? (0.5)

c. For equivalent positive reactivity addtions to a critical reactor, will the SUR be larger or smaller at EOL compared to BOL? (0.5)

QUESTION 1.09 (3.00)

a. Why must the primary system flowrate be approximately 10 times greater than secondary system flowrate? (1.5)

b. Why is a primary heat balance considered less accurate than a secondary heat balance? (1.5)

QUESTION 1.10 (2.00)

Assume that your plant has experienced a degraded power condition and that you are monitoring the plant's cooldown on natural circulation. Explain whether and why you agree or disagree with the following statements:

a. A slow downward trend in indicated Tave is a good indication of well-established natural circulation flow. (1.0)

b. A difference between wide-range Th and wide-range Tc of 65°F and slowly increasing, indicates developing natural circulation flow. (1.0)

QUESTION 1.11 (2.00)

Explain why you agree or disagree with each of the following statements:

A. Equilibrium Xenon at 100% power is about twice as much as equilibrium Xenon at 50% power. (1.0)

B. Equilibrium Samarium at 100% power is about twice as much as equilibrium Samarium at 50% power. (1.0)

QUESTION 2.01 (3.00)

a. Describe the automatic positioning of the steam generator feedwater regulating valve to the downcomer during a power level increase from 0% to 100% power. EXPLAIN why the valve position is programmed in this manner. (1.5)

b. Following a reactor trip from 100% power how will the feed pumps and feed regulating valves control steam generator water level? (Assume all systems in automatic). (1.5)

QUESTION 2.02 (1.00)

What system design feature ensures the MSIV's can be closed following a loss of off-site power and Instrument and Service air system? Explain. (1.0)

QUESTION 2.03 (3.00)

Sketch a one line diagram of the auxiliary feedwater system from the source(s) of water to the steam generators. Include pumps, major control valves, and interfaces with other plant systems. INDICATE which valves and pumps would be actuated on an auxiliary feed actuation signal (AFAS). (3.0)

QUESTION 2.04 (1.75)

a. After a complete loss of normal AC power, what provides flow through the core during;

1. Short term? (first three minutes) (0.50)

2. Long term? (next three minutes to ten hours) (0.50)

b. How does the design of the RCS enhance long term cooling? (0.75)

QUESTION 2.05 (3.25)

a. What three signals will automatically start the Diesel Generator? (0.75)

b. What TWO TYPES of governor control are used on the Diesel Generators? Explain briefly which type is preferred for normal operations and why? (1.75)

c. What THREE diesel protective trips are not blocked during emergency mode operation? (0.75)

QUESTION 2.06 (3.00)

After extensive operation, gasses will tend to accumulate in the steam space of the pressurizer;

a. Why will the gasses tend to build up in the pressurizer? (1.5)

b. How will excess gas in the vapor space of the pressurizer be removed? (1.5)

QUESTION 2.07 (3.00)

The following concerns the control rod drive system:

a. The following concern failure of a CEA lift coil with the rod fully withdrawn;

 1. Explain why the rod WILL or WILL NOT drop.

 2. Explain why the rod WILL or WILL NOT move on a demand signal. (1.5)

b. What means exist to determine whether a control rod is withdrawing properly? (Five SEPERATE sytems indications required) (1.5)

QUESTION 2.08 (1.50)

a. Two fuel pool cooling pumps and two heat exchangers are required for cooling the fuel pool when 13 one-third cores are stored. What cooling changes are required when a total core is moved to the pool? (1.0)

b. What system is used to cool the fuel pool when the nuclear cooling water system is not avaiaible? (0.5)

QUESTION 2.09 (3.00)

a. What THREE conditions will cause a heater drain pump to trip, other than manual? (1.5)

b. You observe excessive steam condensation venting from the blowdown stack outlet. What THREE conditions could cause this to happen? (1.5)

QUESTION 2.10 (2.50)

a. Explain how the shutdown cooling system is protected from overpressurization. (Disregard any relief valves in the SDC system) (1.5)

b. How do you determine what ACTUAL shutdown cooling loop pressure is when shutdown cooling is operating? (1.0)

QUESTION 3.01 (4.00)

Two plant protection system trips, High Local Power Density and Low DNBR, are generated by the Core Protection Calculators.

a. What is the purpose of each of these trips? (1.5)

b. List 6 inputs to the core protection calculator which are used to generate these trips. (1.8)

c. What control action takes place when the pre-trip setpoints are reached? (0.7)

QUESTION 3.02 (3.75)

Will the following changes cause the core protection calculator (CPC) values for the Departure from Nucleate Boiling Ratio (DNBR) and the Local Power Density (LPD) to be:

1. Closer to a trip set point
2. Further from a trip set point
3. Greater than a trip set point
4. Unchanged

Briefly explain each answer.

a. Both CEA position computers fail. (1.25)

b. Speed indication of a RCP is lost. (1.25)

c. Axial Shape Index (ASI) decreases from +0.4 to +0.2. (1.25)

QUESTION 3.03 (2.00)

Assume plant operations at 60% power with CEDMCS in the Auto Sequential mode. Loop 1B Tc instrument fails open and Tave is selected to average. Explain what happens to the Reactor Regulating system and WHY. (2.0)

QUESTION 3.04 (3.00)

How would the following indications be affected (INCREASE, DECREASE or NO CHANGE) by the associated condition change listed below? Consider each indication separately and EXPLAIN your answer.

INDICATION	CONDITION CHANGE	
a. Nuclear Wide Range Instrument	Cold leg temperature increases 50 degrees F at constant true nuclear power	(1.0)
b. Pressurizer level	Differential pressure transmitter reference leg temperature increases 10 degrees F.	(1.0)
c. Steam Generator level	Control steam flow signal increases (no change in actual steam flow)	(1.0)

QUESTION 3.05 (2.80)

a. With the CEA control system in automatic sequential (AS), how can power be reduced from 100% to 80% without producing CEA motion? (0.8)

b. What inputs and calculations are used in the Reactor Regulating System (RRS) to produce a CEA motion demand signal. (2.0)

QUESTION 3.06 (2.70)

a. What signals will give an automatic reactor power cutback signal? (Two required) (1.2)

b. Explain what plant conditions are required before a turbine runback will occur following a reactor power cutback. (1.5)

QUESTION 3.07 (1.50)

Under what TWO conditions will the SBCS block the quick-opening of the Turbine Bypass valves? (1.5)

QUESTION 3.08 (1.50)

Describe what happens in the Feedwater control system upon receiving a reactor tripped override (RTO) signal. Include any additional control signals the system receives. (1.5)

QUESTION 3.09 (3.00)

Match the following indications/parameters you would use to differentiate between the two accidents within each group. (Assume steady state 70% reactor power).

1. Small LOCA outside containment AND S/G tube rupture (3 required)
2. Small LOCA inside containment AND feedwater break inside containment upstream check valve (7 required)
3. Steam break outside containment AND small LOCA outside containment (5 required)

a. Tave
b. RCS pressure
c. Przr. level
d. VCT level
e. Containment: pressure, temperature, humidity
f. Containment airborne
g. steam flow
h. steam pressure
i. feedwater flow
j. S/G level
k. Air ejector/S/G blowdown activity (3.0)

QUESTION 4.01 (2.75)

The plant is at 90% power in steady state conditions, except a xenon ocsillation, resulting from a previous power transient, is in progress.

a. If the COLSS is inoperable, what indications would alert the operator to the presence of the xenon oscillation? (0.75)

b. What TWO advantages would the COLSS provide if it was operating? (1.0)

c. What actions should be taken if ASI varies by more than 0.05 units from ESI? (1.0)

QUESTION 4.02 (2.80)

If a reactor trip AND safety injection occurred as a result of a steam generator tube rupture:

a. What are FOUR ways the ruptured steam generator could be identified? (1.6)

b. How would the ruptured steam generator be isolated? (1.2)

QUESTION 4.03 (2.00)

a. If equal RADS of alpha, beta and gamma were injested by swallowing, which would cause the highest dose? EXPLAIN. (1.0)

b. Which of the above would present the greatest EXTERNAL radiation dose? EXPLAIN. (Your are wearing protective clothing and safety glasses only). (1.0)

QUESTION 4.04 (1.25)

Explain the probable cause AND the corrective action for an increasing VCT level following isolation of the CVCS charging and ledown system. (Letdown valves CH-LV-110P and CH-LV-110Q shut; charging pumps secured). (1.25)

QUESTION 4.05 (2.00)

Indicate whether each of the following items DOES or DOES NOT have a associated Technical Specifications limit.

a. Reactor Regulating System
b. Turbine Generator Overspeed Trip System
c. Steam Generator Safety Valves
d. Main Feed Pump
e. Fire Detection System (2.0)

QUESTION 4.06 (3.00)

a. During a SG tube rupture, why must the hot leg temperature be less than 571 F prior to isolating the affected SG? (0.5)

b. What actions should be taken to cooldown the RCS following a SG tube rupture if the MSIV for the affected SG fails to shut? (Assume below 535 F) (1.0)

c. During a SG tube rupture, how should the affected SG water water level be controlled, if the affected SG is isolated, the blowdown system is unavailable, and the following indications are present: (1.5)

PZR pressure = 1300 psia
RCS hot leg temperature = 545 F
Affected SG pressure = 900 psia

QUESTION 4.07 (1.50)

Palo Verde emergency procedure 41RO-1ZZ04 (Loss of RCS Flow), gives THREE indications/conditions which indicate a loss of flow. What are these THREE indications/conditions? (1.5)

QUESTION 4.08 (3.20)

If after operating in natural circulation for 2 hours, operator error causes a large reduction in natural circulation flow, how will the following parameters change (INCREASE, DECREASE, or REMAIN THE SAME)? Briefly explain your answer. (Assume no further operator action.)

a. Delta T across the core

b. Core thermocouple temperature

c. Steam generator pressure

d. Steam generator level (3.2)

QUESTION 4.09 (2.10)

As defined in the Station Tagging and Clearance procedure (40AC-0ZZ05) when would you use the following tags?

a. Red Tag

b. Yellow Tag

c. Blue Tag (2.1)

QUESTION 4.10 (2.00)

In the Purification sytem procedure, "Placing a purification ion exchanger in service", there is a sentence that states: "Instruct the nuclear operator to open 2 turns the ion exchanger outlet valve." Why shouldn't the nuclear operator open the outlet valve to the full open postion? (2.0)

QUESTION 4.11 (2.40)

According to the Emergency Operations Diagnostic Procedure (41EP-1ZZ01), what reports will the following operators make to the Control Room Supervisor (CRS)?

a. Primary operator (four required) (1.2)

b. Secondary operator (four required) (1.2)