OPERATOR LICENSE EXAMINATION REPORT
No. 50-313/OL-85-02

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

Docket No.: 50-313 License No.: DPR-51

Operator License examinations at Arkansas Nuclear One - Unit 1 (ANO1)

Chief Examiner: John L. Pellet 6-24-85
John L. Pellet Date Signed

Approved by: R. A. Cooley 6-24-85
R. A. Cooley, Section Chief Date Signed

Summary

Operator license examinations for three (3) Reactor Operator candidates and seven (7) Senior Reactor Operator candidates were administered at the ANO1 facility during the week of May 20, 1985. All of the Reactor Operator candidates and six (6) of the seven (7) Senior Reactor Operator candidates passed these examinations and have been issued the appropriate licenses.

ANO1 OPERATOR LICENSE EXAMINATION REPORT

Report Details

1. **Persons Examined**

SRO Candidates:

PASS	FAIL	TOTAL
6	1	7

RO Candidates:

PASS	FAIL	TOTAL
3	0	3

2. **Examiners**

J. Pellet, NRC (Chief Examiner)
W. Apley, PNL-Battelle

3. **Examination Report**

This examination report is composed of the following sections:

A. Examination Review Comment Resolution
B. May 23, 1985 Exit Meeting Summary
C. Generic Comments
D. Examination Master Keys (SRO/RO Questions and Answers)

Performance results for individual candidates are not included in this report because these reports are placed in NRC's Public Document Room.

A. Examination Review Comment Resolution

In general, editorial comments or changes made during the exam, the exam review, or subsequent grading reviews are not addressed by this resolution section. This section reflects resolution of substantive comments made during the exam review on May 21, 1985 and contained in AP&L Memorandum ANO-85-06761. The modifications discussed below are included in the master exam key which is provided elsewhere in this report, as are all other changes mentioned above but not discussed herein. The following personnel were present for the exam review:

ANO1 OPERATOR LICENSE EXAMINATION REPORT

NRC	UTILITY	
J. Pellet	A. Elliot	E. Force
W. Apley	D. Smith	A. South
	E. Wentz	C. Zimmerman

COMMENTS

1. 1.03.	The current terms in use at ANO1 are beta, beta-core, & beta-effective.
Resp.:	ACCEPT. See modified key.
2. 1.07.	The reactor may stay subcritical given initial cond.
Resp.:	ACCEPT. See modified key.
3. 1.12/5.01.	Question states final power is 50% AND if ALL control systems are in manual then Tave will vary with power roughly constant due to EHC in manual.
Resp.:	ACCEPT. Question does NOT state given power is FINAL. Key modified to reflect EHC in manual.
4. 5.08.	Reactor power removal in natural circulation should not require calculation. Answer should be 5-15%.
Resp.:	ACCEPT. Key modified (calc. never req'd.).
5. 5.09.	Question is inappropriate material, answer is unclear from question, and so question should be thrown out.
Resp.:	NO. Question deals with basic fluid flow knowledge. Key modified to clarify knowledge required.
6. 6.01.	Full credit for describing how and why the vent valves function.
Resp.:	ACCEPT. Only if answer complete.
7. 6.03.	Add as correct answers: 1) prevent HPI pump runout and 2) limit flow to an HPI line break.
Resp.:	ACCEPT. See modified key.
8. 6.04.	Accept 1800 ppm is required per plant procedures.
Resp.:	ACCEPT. If per procedure is specified. See modified key.
9. 6.12.	Original BF_3 detectors are not used and should not be required for full credit.
Resp.:	ACCEPT. See modified key.
10. 6.13.a.	Correct answer is YES (but flow blocked by vector logic if the other OTSG pressure is high).
Resp.:	ACCEPT. See modified key.
11. 7.03.	Specific answers to requested conditions may be limited to abnormal transients, unknown trip cause, and ESAS.
Resp.:	NO. The conditions listed are verbatim from procedures. Partial credit is given for each condition and all conditions are not required for passing-credit on this question.
12. 7.05.	May get more explanation than in key.
Resp.:	ACCEPT. Full credit if additional information correct.

13.	7.06.	May get more explanation than in key.
	Resp.:	ACCEPT. Full credit if additional information correct.
14.	7.07.	Correct answer is isolate ltdn by closing either CV1222 and CV1223 or CV1221.
	Resp.:	ACCEPT. See modified key.
14.	7.10.	6th action for CR evac varies with time available.
	Resp.:	ACCEPT. See modified key.
15.	8.07.	Format (1/6 missing) and content (chain of command) are not appropriate for SRO examination. Question should be withdrawn.
	Resp.:	NO. Question is of low value but is appropriate material.
16.	8.08.	Tagging switchyard breakers should be an acceptable answer.
	Resp.:	ACCEPT. See modified key.
17.	8.12.	Question requires memorization of definitions of Emergency action classes and classification tables and are beyond the scope of the SRO exam.
	Resp.:	NO. Question requires recognition of definitions and basic understanding of event classification to achieve passing-credit for the question. As such it is considered as testing general knowledge of procedures - not memorization.

B. May 23, 1985 Exit Meeting Summary

At the conclusion of the site visit, the examiners and the Senior Resident Inspector met with representatives of the plant staff to discuss the results of the examinations. The following personnel were present for the exit interview:

NRC	UTILITY	
W. Apley	J. Levine	J. Vandergrift
W. Johnson	J. McWilliams	E. Force
J. Pellet	L. Humphrey	E. Wentz

Mr. Pellet started the discussion by noting that the examiners as a group had encountered a positive, helpful attitude in everyone concerned. The following general topics were discussed.

1. Preliminary results for the eight oral examinations administered are all clear passes. These results are subject to regional review.
2. An area of weakness does not imply unacceptable performance by any candidate. A weak area is simply one where knowledge or skill is less completely developed than in other areas.
3. NRC will attempt to return formal results within 30 days of leaving the site.

4. The following areas of weakness were observed in more than one candidate.
   a. Multiple casualty events that involved performing required steps from several procedures showed some confusion by some candidates.
   b. The chain of command during emergency events which activated the emergency plan was unclear to most candidates.
   c. There was some confusion on lines of authority within the plant, e.g., who must perform surveillance tests or who can sign for the HP Supervisor when he is not available.
5. The following areas of plant operation or design were considered to have some deleterious effect on candidates.
   a. Some jumpers have been in place for more than 2 years. This appears to be used in place of a DCR.
   b. Job orders may or may not be retrievable from the notebooks in the control room.
   c. Some control room instruments are labeled with number only and some have plastic tape labels.
   d. RB sump level indicates in % but tech. spec. is in gal/inch.
   e. SPDS should have the 5 highest incore thermocouples displayed without using the ATOG display.
   f. Hold card request installation authorization signature block should specify shift supervisor.
   g. Page 33 of the control room tech specs has an unauthorized hand labeling of a figure.
   h. Labeling on the MET for wind information says use the 40' not 190' information.
   i. ICW flow was pegged high greater than the 2500 gpm limit by an unknown amount.

C. GENERIC COMMENTS

No generic weaknesses or problem areas were identified during examination grading. The overall average score in the theory and procedures categories was about 10 points less than in the systems and administrative categories for the SRO candidates.

D. EXAMINATION MASTER COPY (SRO/RO QUESTIONS AND ANSWERS)

The RO and SRO examination master and answer keys follow, including the formula sheet and figure supplied during the examination.

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: _ARKANSAS_NUCLEAR_ONE-1__

REACTOR TYPE: _PWR-B&W177______________

DATE ADMINISTERED: _85/05/21______________

EXAMINER: _PELLET,_J.______________

APPLICANT: ________________________

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	100.00	________	________	1. PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW
25.00	100.00	________	________	TOTALS

FINAL GRADE _______________%

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

____
APPLICANT'S SIGNATURE

QUESTION 1.01 (2.00)

Explain how ANO1 would respond to a turbine bypass valve stuck open with a leak rate of 2% full steam flow for each of the conditions below.

a. All systems normal and in automatic. (1.0)

b. Diamond Panel is in manual and all other systems normal. (1.0)

QUESTION 1.02 (2.00)

Give two (2) reasons why a visible neutron level is required during a reactor startup.

QUESTION 1.03 (2.00)

a. True or False? After a reactor scram, 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-bar-effective over core life affect the STABLE reactor period after a scram? (0.5)

c. Explain why Beta-bar-effective changes over core life. (1.0)

QUESTION 1.04 (1.00)

The reactor is subcritical with a K-eff of 0.960. Source channels are indicating 5 counts per second (cps). What is K-eff when source channels show a count rate of 60 cps after rods are withdrawn? SHOW ALL WORK FOR FULL CREDIT.

QUESTION 1.05 (1.00)

Explain how and why moderator temperature coefficient (MTC) changes over core life.

QUESTION 1.06 (2.00)

TRUE or FALSE? NO explanation required.

a. The operator can increase the heat removal rate from the RCS by reducing steam pressure, or increasing OTSG level.
b. A LOCA with no RCP's running can result in more inventory loss than a LOCA with RCP's running.
c. A total and prolonged loss of OTSG feed can lead to a loss of RCS liquid inventory.
d. The primary concern when fuel clad temperature reaches 1400 degrees F is the production of hydrogen.

QUESTION 1.07 (3.00)

During a reactor startup, with the reactor subcritical at 1000 cps, an atmospheric dump valve fails opens with the isolation valve open.

a. Explain what happens to reactor power and Tave. (Assume the reactor is undermoderated, at BOL, and no reactor trip occurs.) (1.5)
b. Explain any changes that would occur in plant response if the transient occurred at EOL conditions. (1.5)

QUESTION 1.08 (3.00)

Define a "prompt critical" reactor and calculate the startup rate for ANO1 if it were "prompt critical." SHOW ALL WORK FOR FULL CREDIT.

QUESTION 1.09 (2.00)

Match the blanks in the paragraph below dealing with water hammer with the appropriate choice from the list below. Each choice on the list may be used more than once or not at all.

The __a__ the diameter of the line, the __b__ the head, and the __c__ the flow velocity, the greater the danger of water hammer. There is usually more danger of water hammer in __d__ waterlines than in __e__ waterlines.

1. larger	4. horizontal	7. empty
2. smaller	5. straight	8. full
3. vertical	6. curved	

(***** CATEGORY 01 CONTINUED ON NEXT PAGE *****)

QUESTION 1.10 (3.00)

Explain why the following statements are not accurate.

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 Tc of 65 degrees F and slowly increasing is a good indication of natural circulation flow. (1.0)

c. Natural circulation flow rate can be increased by rapidly decreasing secondary steam flow rate. (1.0)

QUESTION 1.11 (2.00)

Match the blanks in the paragraph on rod worth with the appropriate choice from the list below. Each choice may be used more than once or not at all.

The distance over which a control rod is effective is roughly equal to the __a__ in the reactor. The overall worth of the rods __b__ equal to the sum of the worth of each rod. The overall rod-worth is a function of rod __c__ and __d__. A(n) __e__ rod-worth curve shows the change in rod-worth per unit length. A(n) __f__ rod-worth curve represents the slope of a(n) __g__ rod-worth curve. A(n) __h__ curve shows the total reactivity introduced by placing a rod at a given position.

1. integral
2. differential
3. amount of fuel
4. number of rods
5. is
6. is not
7. diffusion length
8. spacing
9. location
10. reactivity excess

QUESTION 1.12 (2.00)

Explain which of the two power histories below will result in the greater final, steady-state power. Assume all control systems are in manual and no operator action takes place. For both cases the plant has been operating at 100% power for an extended time (>1 month).

a. Reactor power is RAPIDLY (~4 hrs) reduced to 50%.

b. Reactor power is SLOWLY (~10 hrs) reduced to 50%.

(***** END OF CATEGORY 01 *****)

(************* END OF EXAMINATION ***************)

ANSWERS -- ARKANSAS NUCLEAR ONE-1 -85/05/21-PELLET, J.

ANSWER 1.01 (2.00)

a. Tavg will drop initially due to excess steam flow (0.3). The turbine will reduce load (close GV) to maintain header pressure which will raise Tavg (0.3). ICS will adjust rods to control Tavg (0.4).
b. Tavg will drop initially due to excess steam flow (0.3). The turbine will reduce load (close GV) to maintain header pressure which will raise Tavg (0.3). ICS will be in TRACK so Tavg error will be adjusted by controlling feedwater (0.4).

REFERENCE
ANO Sample Questions and Answer Keys, Q1.2 (0CAN068314)
B&W ICS MANUAL

ANSWER 1.02 (2.00)

1. Indicate proper operation of nuclear instrumentation. (1.0)
2. Allow the operator to monitor the approach to criticality. (1.0)

REFERENCE
ANO Sample Questions and Answer Keys, Q1.8 (0CAN068314)

ANSWER 1.03 (2.00)

a. TRUE.
b. NONE. (Period is based on the lifetime of longest-lived precursors which is ~55 seconds. Change in BBeff MAY result in reaching stable period sooner due to faster response.)
c. B(B)eff changes due to change in fuel composition (Pu incr., U decr.).

REFERENCE
ANO Sample Questions and Answer Keys, Q1.9, 1.43 (0CAN068314)
ATTS Reactor Theory Manual, Chapter 2
Basic Reactor Theory
ANSWER VERIFIED DURING FACILITY REVIEW

ANSWER 1.04 (1.00)

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CR1/CR2 = (1-K2)/(1-K1)          (0.5  PROPER FORMULA)
K2 = 1 - CR1/CR2 * (1-K1)        (0.25  PROPER USE OF FORMULA)
   = 1 - 5/60*(1-0.960)
   = 1 - 0.00333
K2 = 0.9967                      (0.25  MATHEMATICS)
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REFERENCE
ANO Sample Questions and Answer Keys, Q1.14 (0CAN068314)
ATTS Manual

ANSWER 1.05 (1.00)

MTC becomes MORE (0.2) negative due to decreased boron concentration (0.8).

REFERENCE
ANO Sample Questions and Answer Keys, Q1.21 (0CAN068314)

ANSWER 1.06 (2.00)

a. T
b. F
c. T
d. T

REFERENCE
ANO Sample Questions and Answer Keys, Q1.47 (0CAN068314)
B&W ATOG Guidelines, Part II, Vol. 1

ANSWER 1.07 (3.00)

a. High steam flow causes decr. Tave which inserts pos. react (0.5). Power increases to POAH (0.5) where fuel or doppler turns power until demand = output (0.5).
b. Rate of power rise will be faster (0.5) due to smaller beta (0.5) and larger MTC (0.5). Final power will be the same but at higher temperature (0.5) due to larger MTC. OR Answer may assume that the reactor starts and stays subcritical if otherwise consistent.

REFERENCE
ANO1 Reactor Theory, part 17, p. 27

ANSWER 1.08 (3.00)

"Prompt critical" is critical on prompt neutrons alone (0.5)

FORMULAS: p = l/Keff*T + B/(1+t*T) (0.375) SUR = 26/T (0.375)
p=reactivity l=effective neutron lifetime
T=period B=effective delayed neutron fraction
t=avg. decay constant for neutron emitters
SUR=startup rate

ASSUMPTIONS: by definition, neglect delayed neutrons (0.5)
l=1EE-05 (0.25)
0.005<B<0.007 (0.25)
Keff>1.0068 (0.25)

T = l/Keff*p ~ 1EE-05/1*0.01 ~ 1EE-03 or 0.001 seconds (0.25)

SUR = 26/T = 26/0.001 ~ 26,000 DPM (0.25)

REFERENCE
ANO Nuclear Reactor Theory, p. 97-99

ANSWER 1.09 (2.00)

a., b., c.: all 1
d. 3, e. 4 or d. 7, e. 8 (5 answers @ 0.4 ea.)

REFERENCE
ANO1 Nuclear Fundamental Phase of the Nuclear Power Plant Operator, p. 21

ANSWER 1.10 (3.00)

a. Tave is not a good indication because it is Th+Tc/2.
Tave is not directly tied to the actual plant response & it can change due to only 1 parameter changing (i.e., Tc decr.).
b. For natural circulation, Tc, Th, & dT all tend to decrease once nat. circ. is established.
c. Decr. stm. flow will incr. Pstm & Tsat. This will decr. ht across the OTSG tubes.

REFERENCE
ANO1 AOP 1203.13, p.1
EO 1203.01, p. 71
STM-1-69, p. 12

ANSWER 1.11 (2.00)

a. 7, b. 6, c. 8/9, d. 9/8, e. 2, f. 2, g. 1, h. 1
if c=8 then d=9 & vice versa (8 answers @ 0.25 ea.)

REFERENCE
ANO1 Nuclear Reactor Theory, p. 137-140

ANSWER 1.12 (2.00)

B will have a higher final steady-state power. In case B, Xe will build to a peak during the power change so to get a given power change less boron/rods would be required. Since Xe-eq is the same in each case, final power will be higher for the case involving less boron/rod change.

OR

If assume EHC in manual then power is the same in each case since steam flow constant. Xe changes are as above but they affect Tave not power. Therefore accept 2 cases have the same power if explained.
(case - 1.0, Xe peak - 0.5, Xe-eq - 0.5)

REFERENCE
ANO Sample Questions and Answer Keys, Q1.6 (0CAN068314)
ATTS Manual on Reactor Theory
Basic Reactor Theory
ANSWER VERIFIED DURING FACILITY REVIEW

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

FACILITY: ARKANSAS NUCLEAR ONE-1

REACTOR TYPE: PWR-B&W177

DATE ADMINISTERED: 85/05/21

EXAMINER: PELLET, J.

APPLICANT: ______________________

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	25.00	________	________	5. THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS, AND THERMODYNAMICS
25.00	25.00	________	________	6. PLANT SYSTEMS DESIGN, CONTROL, AND INSTRUMENTATION
25.00	25.00	________	________	7. PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL
25.00	25.00	________	________	8. ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS
100.00	100.00	________	________	TOTALS

FINAL GRADE ________________%

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

____
APPLICANT'S SIGNATURE

QUESTION 5.01 (3.00)

For each of the conditions listed below, explain how reactor power would change over 100 hours. Assume all control systems are in manual and no operator action takes place. For both cases the plant has been operating at 100% power for an extended time (>1 month). Compare the final steady-state power for the two cases.

a. Reactor power is RAPIDLY (~4 hrs) reduced to 50%. (1.5)
b. Reactor power is SLOWLY (~10 hrs) reduced to 50%. (1.5)

QUESTION 5.02 (1.00)

The reactor is subcritical with a K-eff of 0.960. Source channels are indicating 5 counts per second (cps). What is K-eff when source channels show a count rate of 60 cps after rods are withdrawn? SHOW ALL WORK FOR FULL CREDIT.

QUESTION 5.03 (2.00)

TRUE or FALSE? NO explanation required.

a. The operator can increase the heat removal rate from the RCS by reducing steam pressure, or increasing OTSG level.
b. A LOCA with no RCP's running can result in more inventory loss than a LOCA with RCP's running.
c. A total and prolonged loss of OTSG feed can lead to a loss of RCS liquid inventory.
d. The primary concern when fuel clad temperature reaches 1400 degrees F is the production of hydrogen.

QUESTION 5.04 (3.00)

Define a "prompt critical" reactor and calculate the startup rate for ANO1 if it were "prompt critical." SHOW ALL WORK FOR FULL CREDIT.

(***** CATEGORY 05 CONTINUED ON NEXT PAGE *****)

QUESTION 5.05 (3.00)

Calculate the time required for reactor vessel hulk water temperature to reach 212 degrees F for the conditions below. STATE ALL ASSUMPTIONS AND SHOW ALL WORK FOR FULL CREDIT.

a. The reactor has been shutdown for 100 hours after a 250 day run @ 100%.
b. ALL means of removing heat from the vessel are lost.
c. No circulation to the primary loops occurs.
d. Reactor vessel water is initially at 112 degrees F and well mixed.
e. The reactor vessel head is de-tensioned but still sealed.

QUESTION 5.06 (2.00)

Match the blanks in the paragraph on rod worth with the appropriate choice from the list below. Each choice may be used more than once or not at all.

The distance over which a control rod is effective is roughly equal to the __a__ in the reactor. The overall worth of the rods __b__ equal to the sum of the worth of each rod. The overall rod-worth is a function of rod __c__ and __d__. A(n) __e__ rod-worth curve shows the change in rod-worth per unit length. A(n) __f__ rod-worth curve represents the slope of a(n) __g__ rod-worth curve. A(n) __h__ curve shows the total reactivity introduced by placing a rod at a given position.

1. integral	5. is	9. location
2. differential	6. is not	10. reactivity excess
3. amount of fuel	7. diffusion length	
4. number of rods	8. spacing	

QUESTION 5.07 (3.00)

State the three (3) types of control rods and briefly explain the function of each.

QUESTION 5.08 (1.00)

What percentage of reactor power can be removed by natural circulation? Base your answer on heat transfer analyses, not procedural limitations.

QUESTION 5.09 (2.00)

The following statement is a simplification of a more general statement concerning fluid flow.
"FLUID FLOWS FROM A HIGH PRESSURE AREA TO A LOW PRESSURE AREA."
a. Under what conditions is this simplification accurate?
b. What is the general statement this simplification is derived from?

QUESTION 5.10 (1.00)

a. True or False? After a reactor scram, 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-bar-effective over core life affect the STABLE reactor period after a scram? (0.5)

QUESTION 5.11 (2.00)

Explain how the four (4) basic resistances to heat transport in the core, listed below, INITIALLY change as a result of a LOCA?
a. thermal resistivity of the fuel material.
b. thermal resistivity of the fuel-clad gap.
c. thermal resistivity of the clad material.
d. thermal resistivity of the clad-coolant gap.

QUESTION 5.12 (2.00)

When the reactor is at a stable 15% power it is discovered that Tave is not in the programmed band. How does changing the level setpoint on both Once-Through Steam Generators (OTSG's) restore Tave to the programmed band?

(***** END OF CATEGORY 05 *****)

QUESTION 6.01 (1.00)

Explain the basic function of the Reactor Internals Vent Valves and what event they are designed to help mitigate by opening.

QUESTION 6.02 (3.00)

State six (6) functions performed by the Makeup and Purification System in direct support of the Reactor Coolant System.

QUESTION 6.03 (2.00)

Describe two (2) reasons that flow orifices are installed in the high pressure injection headers. Do NOT use flow measurement as an answer.

QUESTION 6.04 (.50)

TRUE of FALSE? The water in the spent fuel storage pool must be borated to a minimum concentration of 1800 ppm for safe storage of spent fuel assemblies.

QUESTION 6.05 (1.00)

Describe the basic design feature(s) of the main condenser which minimize condensate depression.

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

QUESTION 6.06 (3.00)

State whether each of the statements below about the fire protection system are TRUE or FALSE. No explanation is required.

a. Diesel generator room fire protection spray will occur when the deluge valve has opened.
b. Manual operator action is required to complete actuation of the Reactor Building fire protection pre-action spray system.
c. The Halon System distributes halon to the Control Room ceiling and the Auxiliary Control Room floor and ceiling.
d. The Cardox automatic CO2 fire extinguishing unit may be operated by manually operating the pilot valve stations on a loss of power.
e. The Cardox CO2 System uses Fenwal Detect-a-Fire and Protomatic heat-actuating devices.
f. The motor-driven jockey pump cycles on at 110 psig and off at 125 psig.

QUESTION 6.07 (2.00)

Explain two (2) diverse design features which prevent overpressurization of the Decay Heat Removal (DHR) system.

QUESTION 6.08 (1.00)

Describe the plant condition(s) where the two (2) types of rod position indication can be expected to disagree. (1.0)

QUESTION 6.09 (3.00)

a. List the four (4) reactor trips which are bypassed when the reactor is shutdown and the Reactor Protective System (RPS) is placed in the "Shutdown bypass" mode. (1.0)
b. List the two (2) reactor trips imposed by the actions in a. (1.0)
c. List the three (3) conditions which must be met to initiate the bypass. (1.0)

(***** CATEGORY 06 CONTINUED ON NEXT PAGE *****)

QUESTION 6.10 (3.00)

For the cases below, describe how ICS and the plant would respond to the conditions given. Assume each case is independent, all plant conditions are normal, and control systems in automatic. Figure 64.1, attached, shows a simplified drawing of the ICS.

a. The NSSS Demand from the SG - Reactor increases 10% while a BTU limit from T(hot) exists on feedwater. (1.5)
b. The NSSS Demand from the SG - Reactor increases 10% while the CRD out relay is stuck (no outward rod motion available). (1.5)

QUESTION 6.11 (1.50)

What are five (5) conditions which cause ICS tracking (Tracking Relay T1)?

QUESTION 6.12 (3.00)

Provide the information requested below about the three (3) ranges of the Nuclear Instrumentation (NI) system.

a. Range name. (0.3)
b. Detector type. (0.4)
c. Number of detectors per range. (0.4)
d. Type of flux detected (i.e., represented at detector output). (0.4)
e. Type of flux indicated (i.e., indicated on panel meter). (0.4)
f. Detector range. (0.4)
g. Reactor trips (setpoints NOT required). (0.7)

QUESTION 6.13 (1.00)

For each case below, state whether Emergency Feedwater (EFW) would actuate.

a. OTSG A level at 10 inches and pressure at 200 psig. (0.5)
b. Loss of offsite power. (0.5)

(***** END OF CATEGORY 06 *****)

QUESTION 7.01 (2.00)

What actions are required by the Shift Supervisor to permit skipping normal system lineup verifications during a reactor startup following a scheduled maintenance shutdown for those systems on which maintenance was not performed?

QUESTION 7.02 (2.50)

Using the data presented below, explain if either a PROCEDURE or TECHNICAL SPECIFICATION heatup rate limit has been exceeded.

TIME(minutes)	RCS TEMPERATURE(degrees F)
0	300
15	320
25	330
40	350
65	390
90	440
100	450

QUESTION 7.03 (2.50)

Explain which plant personnel may authorize a restart AND under what plant conditions they may do so per 1102.06, "Reactor Trip Recovery" procedure.

QUESTION 7.04 (1.50)

What are the conditions where a startup may continue without observing a doubling count during withdrawal of the safety groups per 1102.08, "Approach to Criticality"?

QUESTION 7.05 (3.00)

Describe how a pressurizer steam bubble is formed during startup. Include the criteria used to confirm a steam bubble exists in the pressurizer.

(***** CATEGORY 07 CONTINUED ON NEXT PAGE *****)

QUESTION 7.06 (3.00)

a. Explain the most likely cause for a large increase in pressurizer level during depressurization after a natural circulation cooldown. (1.5)
b. Describe the appropriate corrective action if this large level increase occurs. (1.5)

QUESTION 7.07 (3.00)

What immediate actions (IA's) are required if BOTH Main Feedwater Pumps trip with the plant operating at 30% power? Include in your answer the IA's PLUS the operator actions or verifications needed to complete each IA.

QUESTION 7.08 (1.00)

State (YES/NO) if natural circulation and heat rejection to the secondary system are indicated by each of the following parameters.
a. Reactor coolant temperatures decreasing.
b. RCS hot-cold leg temperature differential stable at 40 degrees F.
c. EFW actuated and supplying feedwater to both OTSG's.
d. Turbine bypass valves open to control steam pressure.

QUESTION 7.09 (2.00)

What immediate actions (IA's) are required for an OTSG Tube Rupture event per EOP 1202.01? Assume a reactor trip occurs before a runback can be performed. Include in your answer operator actions required to complete each IA. Confirmatory actions (i.e., "Verify ...") OR actions required for a reactor trip are NOT required.

QUESTION 7.10 (2.50)

What are five (5) immediate actions required if a fire in the Control Room renders the Control Room uninhabitable? If a specific sequence is required for the actions listed then include it in your answer.

QUESTION 7.11 (1.00)

What is the maximum allowable period for each of the RWP classes or categories listed below?

a. Category I.
b. Category II.
c. Category III.
d. Standing.

QUESTION 7.12 (1.00)

a. What are the ANO1 weekly, quarterly, and yearly whole body exposure limits for personnel with complete exposure records? (0.75)
b. Who (by job title) must approve weekly whole body exposure above the administrative limit? (0.25)

(***** END OF CATEGORY 07 *****)

QUESTION 8.01 (2.50)

Complete the table below on reactor operating conditions or modes per Technical Specifications. (NOTE: NAR = No Answer Required.)

OPERATING CONDITIONS	Taverage	REACTIVITY	REACTOR POWER
Refueling Shutdown	(a)	(b)	NAR
Cold Shutdown	(c)	(d)	NAR
Hot Shutdown	(e)	NAR	NAR
Hot Standby	NAR	(f)	(g)

QUESTION 8.02 (3.50)

a. Fill in the blanks in the following paragraph about reactor building integrity. Each blank may represent one or more words or numbers.
   Reactor building integrity is required whenever all three of the following conditions exist:
   1. Reactor coolant pressure is _____ psig or greater. (0.25)
   2. Reactor coolant temperature is _____ degrees F or greater. (0.25)
   3. _____. (0.5)

b. What are the five (5) conditions which must be satisfied for reactor building integrity to exist? (2.5)

QUESTION 8.03 (1.00)

What are the two (2) Technical Specification Reactor Coolant System activity limits which must be met during steady-state operation?

QUESTION 8.04 (3.00)

Fill in the blanks in the following paragraph dealing with reactor coolant leakage. Each blank may contain one or more words or numbers.

a. If the total reactor coolant leakage rate exceeds _(1)_, the reactor shall be _(2)_ within 24 hours of detection.
b. If the unidentified reactor coolant leakage exceeds _(1)_, the reactor shall be _(2)_ within 24 hours of detection.
c. If reactor coolant leakage through a non-isolable fault in _(1)_ exceeds _(2)_, the reactor shall be _(3)_ within 24 hours of detection.

QUESTION 8.05 (3.00)

What are four (4) changes to procedures that are classified as an "Intent Change" per 1000.06, "Procedure Review, Approval, and Revision Control"?

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.06 (1.00)

Who [by job title(s)] must approve a change to a Safety-Related procedure which is needed immediately and does NOT involve an Intent Change?

QUESTION 8.07 (.50)

Is the Shift Operations Supervisor REQUIRED to assume the responsibility of the Security Coordinator in security-related matters if the Security Coordinator, Human Resources Supervisor, Administrative Manager, Operations Manager, and Operations Superintendent are all absent? (YES or NO only.)

QUESTION 8.08 (1.00)

Manipulation of what plant equipment requires the use of BOTH AP&L Switching Orders and ANO HOLD cards?

QUESTION 8.09 (3.00)

What are three (3) cases where independent verification of HOLD card requirements is required per 1000.27, "HOLD and CAUTION CARD CONTROL"?

QUESTION 8.10 (2.00)

Complete the following statement dealing with Shift Supervisor authority.
The Shift Supervisor shall have specific authority to order power reduction or shutdown if continued operation of the unit will result in:
a. Immediate _____,
b. _____ to station personnel,
c. Violation of _____, or
d. Unnecessary _____.
NOTE: Each blank may contain one or more words or phrases.

QUESTION 8.11 (1.00)

Fill in the blanks in the following paragraph dealing with plant tours.
Each blank may contain one or more words or phrases.
Key shift personnel [_(a)_ and _(b)_] shall not enter areas from which they cannot respond to the _(c)_ within _(d)_ minutes.

(***** CATEGORY 08 CONTINUED ON NEXT PAGE *****)

QUESTION 8.12 (3.50)

a. Match each of the four Emergency Classes (EC's) to the most appropriate PARTIAL definition given below. Each EC may be used more than once or not at all. (2.0)

DEFINITION	EC
___ i. Releases are not expected to exceed EPA Protective Action Guideline exposure levels except near the site boundary.	1. Notification of Unusual Event.
___ ii. Event in progress indicates a potential degradation of the level of safety of the plant.	2. Alert.
___ iii. Event in progress involves substantial core damage.	3. Site Area Emergency.
___ iv. Releases are expected to be a small fraction of the EPA Protective Action Guideline exposure levels.	4. General Area Emergency.

b. Classify each of the events below to the most appropriate EAL. (1.5)
   1. Pressurizer relief valve fails to re-close after lifting.
   2. Control Room evacuation is required.
   3. Reactor Coolant System (RCS) instrumentation indicates the RCS at saturated conditions.

(***** END OF CATEGORY 08 *****)
(************* END OF EXAMINATION ***************)

ANSWER 5.01 (3.00)

a. With all control systems in manual, EHC holds steam flow constant so power stays at ~50% throughout the transient (0.5). Xe is increasing so power starts down so Tave decreases to hold power (0.5). As Xe hits peak and starts to XE-equil. the process reverses. Final stable conditions are power ~50% & Tave higher than normal (0.5).
b. EHC effects are same as case a (0.5) but Xe-peak has passed and, as above, Tave is increasing with Xe decrease (0.5). Final stable conditions are power ~50% & Tave higher than normal (0.5).
(NOTE: Since less -p must be added in case b by the operator to reduce power to ~50% & Xe-eq(a)=Xe-eq(b), then Tave(b) higher).

REFERENCE
ANO Sample Questions and Answer Keys, Q1.6 (0CAN068314)
ATTS Manual on Reactor Theory
Basic Reactor Theory
ANSWER VERIFIED DURING FACILITY REVIEW

ANSWER 5.02 (1.00)

```
CR1/CR2 = (1-K2)/(1-K1)          (0.5  PROPER FORMULA)
K2 = 1 - CR1/CR2 * (1-K1)        (0.25  PROPER USE OF FORMULA)
   = 1 - 5/60*(1-0.960)
   = 1 - 0.00333
K2 = 0.9967                      (0.25  MATHEMATICS)
```

REFERENCE
ANO Sample Questions and Answer Keys, Q1.14 (0CAN068314)
ATTS Manual

ANSWER 5.03 (2.00)

a. T
b. F
c. T
d. T

REFERENCE
ANO Sample Questions and Answer Keys, Q1.47 (0CAN068314)
B&W ATOG Guidelines, Part II, Vol. 1

ANSWERS -- ARKANSAS NUCLEAR ONE-1 -85/05/21-PELLET, J.

ANSWER 5.04 (3.00)

"Prompt critical" is critical on prompt neutrons alone (1.0)

FORMULAS: p = l/Keff*T + (B-p)/tp (0.375) SUR = 26/T (0.375)
p=reactivity l=effective neutron lifetime
T=period B=effective delayed neutron fraction
t=avg. decay constant for neutron emitters
SUR=startup rate

ASSUMPTIONS: p=B (0.5)
l=1EE-05 (0.25)
0.005<B<0.007 (0.25)
Keff>1.0068 (0.25)

T = l/Keff*p ~ 1EE-05/1*0.01 ~ 1EE-03 or 0.001 seconds (0.25)

SUR = 26/T = 26/0.001 ~ 26,000 DPM (0.25)

REFERENCE
ANO Nuclear Reactor Theory, p. 97-99

ANSWER 5.05 (3.00)

ASSUMPTIONS:
a. Vessel water volume = 3000~5000 cu. ft. (0.5)
b. Decayed heat load = 0.1~0.5% rated thermal power (0.5)
c. Rated thermal power = 2500~2600 MW (0.5)
d. Water density = 59.8~61.8 lbm/cu. ft. (0.25)
e. ~57,000 Btu/minute = 1 MW (0.25)
f. 1 Btu will raise 1 lbm water 1 degree F (0.25)

SOLUTION:
g. Water Mass = a*d = 209,300~309,000 lbm (0.1)
h. Heat Load = c*b*e = 2.5~13 MW = 0.14~0.74EE06 Btu/min (0.1)
i. Heat Req'd = g*f*(deltaT=100) = 21~31EE06 Btu (0.1)
j. Time Req'd = i/h = 28~220 minutes = 1/2~3.7 hours (0.45)

REFERENCE
STEAM TABLES
ANO1 Plant Specific Reactor Theory, p. 217-218
ANO1 STM 1-01, p. 1
ANSWER VERIFIED DURING FACILITY REVIEW

ANSWER 5.06 (2.00)

a. 7, b. 6, c. 8/9, d. 9/8, e. 2, f. 2, g. 1, h. 1
if c=8 then d=9 & vice versa (8 answers @ 0.25 ea.)

REFERENCE
ANO1 Nuclear Reactor Theory, p. 137-140

ANSWER 5.07 (3.00)

Control or Regulating Rod: fine react. control over narrow power range.
Safety Rod: S/D or scram or trip the reactor.
Axial Power Shaping Rod or APSR: offset flux imbalance/redistribute flux.
Burnable Poison Rod: allow for higher initial fuel load.
(any 3/4 - name 0.25 ea., function 0.75 ea.)

REFERENCE
ANO1 Nuclear Reactor Theory, p. 141

ANSWER 5.08 (1.00)

5~15%

REFERENCE
ANO1 Nuclear Fundamental Phase of the Nuclear Power Plant Operator, p. 188

ANSWER 5.09 (2.00)

a. Statement is true in areas of high pressure (0.25) & low velocity (0.25) as long as a flow path exists (0.5).
b. General statement is:
Fluid always flows from an area of high total energy to an area of lower total energy.

REFERENCE
ANO1 Nuclear Fundamental Phase of the Nuclear Power Plant Operator, p. 4

ANSWER 5.10 (1.00)

a. TRUE.
b. NONE. (Period is based on the lifetime of longest-lived precursors which is ~55 seconds. Change in BBeff MAY result in reaching stable period sooner.)

REFERENCE
ANO Sample Questions and Answer Keys, Q1.9, 1.43 (0CAN068314)
ATTS Reactor Theory Manual, Chapter 2
Basic Reactor Theory
ANSWER VERIFIED DURING FACILITY REVIEW

ANSWER 5.11 (2.00)

a. constant
b. constant
c. constant
d. increases

REFERENCE
Study Guide - Operator Training - Degraded Core Recognition and Mitigation, TRG-81-3, p. 6-1

ANSWER 5.12 (2.00)

If level increases, more tube area will be water covered so heat transfer will increase (1.0). This will decrease Tave due to increased heat removal (1.0). The opposite will occur for a level decrease.

REFERENCE
ANO1 STM-1-64, p. 9

ANSWER 6.01 (1.00)

1. The vent valves prevent a vessel press. imbalance (concept). (0.5)
2. They will open on a cold leg break (to allow flow from the core directly to the break, thereby reducing reflood time). (0.5)

REFERENCE

ANO1 STM-1-01, p. 7

ANSWER 6.02 (3.00)

1. Control RCS coolant inventory.
2. Purify reactor coolant.
3. Maintain proper boron concentration of the RCS.
4. Provide RCS chemistry control (via N2H4/LiOH/H2 addition).
5. Provide RCS degasification.
6. Supply seal injection water for the RCP's.
7. Supply borated water makeup to the core flood tanks (during rx s/d).
8. Supply HPI to RCS after ESAS.

(any 6/8 answers @ 0.5 ea. - accept reasonable compilation)

REFERENCE
ANO1 STM-1-04, p. 1

ANSWER 6.03 (2.00)

1. Balance flow during SBLOCA, loss of offsite power, 1EDG, 1 HPI, etc.
2. Prevent cavitation/runout of the MU/HPI pumps.
3. Equalize flow losses in unequal piping legs.

(any 2/3 @ 1.0 ea.)

REFERENCE

ANO1 STM-1-04, Table 4.14, p. 1

ANSWER 6.04 (.50)

False. (TRUE if explain req'd per procedures.)

REFERENCE

ANO1 STM-1-07, p. 2

ANSWER 6.05 (1.00)

The condensate must fall through a zone of reheating steam below the tubes.

REFERENCE

ANO1 STM-1-20, p. 1

ANSWER 6.06 (3.00)

a. F, b. T, c. T, d. T, e. F, f. T

REFERENCE

ANO! STM-1-60, p. 1-12

ANSWER 6.07 (2.00)

1. The suction valves are interlocked on high pressure.
2. Suction / discharge piping relief valves are installed.

REFERENCE

ANO1 STM-1-05, p. 1

ANSWER 6.08 (1.00)

They will disagree any time rod motion occurs without activation of the CRDM motor, i.e., on a reactor scram. [1.0]

REFERENCE

ANO1 STM-1-02, p. 7, 8

ANSWER 6.09 (3.00)

a. 1. Low pressure.
   2. Pressure/Temperature.
   3. Power/Imbalance/Flow.
   4. Power/Pumps. (4 answers @ 0.25 ea.)

b. 1. High pressure (1720#).
   2. High flux (5%). (2 answers @ 0.5 ea.)

c. 1. Rx press. below the trip bistable setpoint.
   2. Bistable manually reset.
   3. S/D bypass switch placed in bypass position.
   (3 answers @ 0.333 ea.)

REFERENCE

ANO1 STM-1-63, p. 2

ANSWER 6.10 (3.00)

a. Rx power will increase (0.3) with FW staying the same (0.3) until FWdemand > FWflow + 5% (0.3) which then causes a cross limit (0.3) which will reduce rx power to keep power w/in 5% of FW flow (0.3).

b. FW flow will increase (0.3) and a rod out demand will occur (0.3) until FWflow > FWdemand/Rx power + 5% (0.3) which causes a cross limit (0.3) to reduce FW flow to w/in 5% of rx power (0.3).

REFERENCE

ANO1 STM-1-64, p. 17, 18
ANSWER VERIFIED DURING FACILITY REVIEW

ANSWER 6.11 (1.50)

1. Cross limits.
2. SG - Reactor demand station in hand.
3. Both loop A&B FW demand stations in hand.
4. Diamond rod control station in hand.
5. Reactor demand station in hand.
6. Reactor tripped.
7. Both generator output breakers open.
8. EHC in mode other than ICS.

(any 5/8 answers @ 0.3 ea.)

REFERENCE

ANO1 STM-1-64, Table 64.5

ANSWER 6.12 (3.00)

	SOURCE		INTERMEDIATE	POWER
a.				
b.	[BF3/PC]	FC	CIC	UIC
c.	[2]	2	2	4
d.	[n+g]	n	n	n+g
e.	[n]	n	n	n+g
f.	[.1~10E6cps]	.1cps~200%	10E-11~-3amps	0~125%
g.	[-none-]	-none-	-none-	high flux flux/flow/flux imbal. flux/RCP operating % power/MNTURB/MFWP

[24 answers @ 0.125 ea., g.power=4answers]

REFERENCE

ANO1 STM-1-67, p. 1-3

ANSWER 6.13 (1.00)

a. yes [but vector logic would prevent flow if the other SG @ high press.]
b. yes. [2 answers @ 0.5 ea.]

REFERENCE

ANO1 STYM-1-66, p. 58, 59

ANSWERS -- ARKANSAS NUCLEAR ONE-1 -85/05/21-PELLET, J.

ANSWER 7.01 (2.00)

SS must:
1. Initial as "N/A; maintenance not performed".
2. Check the a.) Plant Log, b.) Hold Card Log, and c.) Work Request Log to ensure that no conditions exist which would prevent operation of the systems which are not lineup-checked.

(answer 1 @ 0.75, answer 2 concept @ 1.25 - specific logs/words not req'd)

REFERENCE

ANO1 Plant Startup, 1102.02, Ref. 30, p. 4

ANSWER 7.02 (2.50)

The procedural limit is 1.67 degrees per minute (0.5). This was violated between 65 ~ 90 minutes where the rate was 2 F/min (0.75).
The tech spec limit is 100 degrees F in any one hour period (0.5). This was violated between ~30 to ~90 when heatup was ~105 F (0.75).

REFERENCE

ANO1 Plant Startup, 1102.02, Rev. 30, p. 9
ANO1 Technical Specifications, 3.1.2, p. 18, 19, 20b

ANSWER 7.03 (2.50)

If any of conditions below occurred then restart authorized only by the Operations Manager (0.8). If none of below then by Ops. Super. (0.8).
Conditions: ESAS actuated.
EFIC actuated.
Major equipment damage.
Trip cause unknown.
RAC's written due to abnormal plant/equip. performance.
EAL declared (any level).
(6 conditions @ 0.15 ea.)

REFERENCE

ANO1 Reactor Trip Recovery, 1102.06, Rev. 7, p. 4

ANSWER 7.04 (1.50)

SR doubling may not occur prior to 100% W.D. on the safety groups if the initial safety rod configuration was partially W.D.
OR
SR doubling ... if the ECP is >100% on group 5.
OR
Going critical on boron with high initial concentration. (any 1/3 @ 1.0)
AND
An increasing count rate during W.D. should be noted (0.5).

REFERENCE

ANO1 Approach to Criticality, 1102.08, Rev. 7, p. 4

ANSWER 7.05 (3.00)

A steam bubble is generated by increasing reactor pressure with a heat source (heaters) (0.75) then venting & blowing down the system to the quench tank via ERV's (0.75). This process is repeated until quench tank pressure increases only ~1 psi for a ~3 minute blowdown (0.75) & the pzr. pressure/temperature relationship exists (0.75).

REFERENCE

ANO1 Pressurizer Operation, 1103.05, Rev. 8, p. 4

ANSWER 7.06 (3.00)

a. During natural circulation, no flow occurs in the head so losses are to ambient and the head cools very slowly (0.75). The head may flash during depress. which creates a pzr in-surge & level incr. (0.75).
b. The proper corrective action is to repressurize (0.75) and slow the cooldown to allow the head to catch up to the bulk RCS (0.75).

REFERENCE

ANO1 Decay Heat Removal Operating Procedure, 1104.04, p. 6

ANSWER 7.07 (3.00)

1. Manually trip the reactor & verify shutdown (0.45)	a. Push the manual trip button. (0.1) b. Verify: all rods on bottom. (0.1) power decr. on IR. (0.1)
2. Verify turbine trip (0.45)	a. Throttle & governor valves closed. (0.1)
3. If subcooling margin is lost (<30F), trip all RCP's (0.45)	a. Loss of subcooling margin: 1. subc. margin recorder. (0.1) 2. SPDS CRT display. (0.1) 3. RSC press./temp. ind. (0.1) 4. Low sat. margin alarms. (0.1) b. If RCP's tripped: 1. Verify EFW act. & cntrl. (0.1) 2. Select REFLUX BOILING EFW (0.1) 3. Ver. HP lift & bkstp oil pump for ea. RCP. (0.1)
4. Isolate letdown. (0.45)	a. Close CV-1222/3 or CV-1221 (0.1) (ltdn orifice & bypass)

REFERENCE

ANO1 Emergency Operating Procedure, 1202.01, p. 3, 4

ANSWER 7.08 (1.00)

a. YES, b. NO, c. YES, d. YES (4 answers @ 0.25 ea.)

REFERENCE

ANO1 EOP, 1202.01, p. 55

ANSWERS -- ARKANSAS NUCLEAR ONE-1 -85/05/21-PELLET, J.

ANSWER 7.09 (2.00)

1. Initiate HPI (0.5)	a. Open BWST suct. valves	(0.1)
	b. Start ES standby MU pump	(0.1)
	c. Open CV-1220/8 to maint. pzr. level	(0.1)
2. Determine the affected SG (0.5)	a. Main steam line N-16 mon.	(0.1)
	b. Local MSL rad. survey	(0.1)
3. Isolate EFW to affected SG (0.5)	No specific actions req'd for full credit (CV-2670/27/67 or 20/26/17)	

REFERENCE

ANO1 EOP, 1202.01, p. 67, 68

ANSWER 7.10 (2.50)

1. Manually trip the reactor. (0.5)
2. Isolate main steam (close CV-2691/92). (0.5)
3. Isolate main feedwater (close CV-2630/80). (0.5)
4. Manually actuate EFW (on EFIC matrices). (0.5)
5. Isolate letdown (close CV-1221). (0.5)

(Step 6 LAST if given - if not last then -0.1; 1-5 any order OK)

6. Trip and place in pull-to-lock:
   a. All H-1 & H-2 (6.9 KV) bus fdr. bkrs. (0.1)
   b. A-309 (Bus A-1 to A-3 tie bkr.). (0.1)
   c. A-301 (B-5 bus fdr. bkr.). (0.1)
   d. A-409 (Bus A-2 to A-4 fdr. bkr.). (0.1)
   e. A-401 (B-6 bus fdr. bkr.). (0.1)

6'. Announce evac. over PA system (6th varies w/ evac. time avail.)

REFERENCE

ANO1 Alternate Shutdown AOP, 1203.02, p. 5

ANSWER 7.11 (1.00)

a. 7 days, b. job duration, c. job duration, d. 1 month
(4 answers @ 0.25 ea.)

ANSWERS -- ARKANSAS NUCLEAR ONE-1 -85/05/21-PELLET, J.

REFERENCE

ANO1 1612.003, Radiological Work Permits, Rev. 5, p. 5

ANSWER 7.12 (1.00)

a. weekly: 300 mrem, quartely: 2500 mrem, yearly: 5000 mrem
b. ACCEPT EITHER: 1. HP Supervisor, OR
2. HP Superintendent for exp. > 600 mrem.
(a: 3 answers @ 0.25 ea.; b: either answer @ 0.25)

REFERENCE

ANO1 1622.011, Exposure Limits and Monitoring Techniques, Rev. 3, p. 3

ANSWER 8.01 (2.50)

a. ~140 F, b. 1% dK/K subcritical w/ all CR removed , c. </= 200 F,
d. 1% dK/K subcrit., e. >/= 525 F, f. Keff=1/critical, g. <2% rx. pwr.
(7 answers @ 0.357 ea.)

REFERENCE

ANO1 TS, Amend. 25, p. 1, 2

ANSWER 8.02 (3.50)

a. 1. 300, 2. 200, 3. Nuclear fuel is in the core. (concept)
(1&2 @ 0.25 ea.; 3 @ 0.5)

b. 1. The equipment hatch is closed and sealed.
2. The personnel & emergency locks are closed and sealed.
3. All non-auto. isol. valves & flanges closed as required.
4. All auto. isol. valves operable or deenergized closed.
5. Leakage within TS limits.
(5 answers @ 0.5 ea. - general concept OK - add'l details OK but NR)

REFERENCE

ANO1 TS 1.7, Amend 50, p. 5
TS 3.6, Amend 57, p. 54

ANSWER 8.03 (1.00)

1. The total specific activity of the primary coolant shall not exceed 72/E-bar uCi/gm (E-bar is sum of avg. beta/gamma energy). (0.5)
2. The I-131 dose equivalent of the primary coolant radioiodine activity shall not exceed 3.5 uCi/gm. (0.5)

REFERENCE

ANO1 TS 3.1.4, Amend. 2, p. 23

ANSWER 8.04 (3.00)

a. 1. 10 gpm, 2. shutdown (2 answers @ 0.5 ea.)
b. 1. 1 gpm, 2. shutdown (2 answers @ 0.5 ea.)
c. 1. RCS strength boundary
   2. 0 gpm / any amount
   3. shutdown and cooldown to cold S/D initiated.
   (3 answers @ 0.333 ea.)

REFERENCE

ANO1 TS 3.1.6, Amend. 57, p. 27

ANSWER 8.05 (3.00)

1. Change in SCOPE.
2. Change in PURPOSE.
3. Degrade controls prescribed in admin. proc.
4. Reduce level of safety (ensured by IC's).
5. Degrade acceptance criteria.
(any 4/5 answers @ 0.75 ea.)

REFERENCE

ANO1 1000.06, Rev. 19, p. 2

ANSWER 8.06 (1.00)

1. Cognizant Supervisor OR knowledgeable member of plant mgmt. staff.
2. Individual SRO-licensed for ANO1.
(2 answers @ 0.5 ea.)

REFERENCE

ANO1 1000.06, Rev. 17, p. 12

ANSWER 8.07 (.50)

NO. (Maint. Mgr. still in chain of command.)

REFERENCE

ANO1 1000.19, Rev. 5, p. 2

ANSWER 8.08 (1.00)

Manipulation of power supplies to the plant (S/U xformer & generators, i.e., switchyard bkrs/disconn) requires both Switching Orders & HOLD cards.

REFERENCE

ANO1 1000.27, Rev. 2, p. 1

ANSWER 8.09 (3.00)

1. Safety system isol. requirements where plant operation is ongoing and/or operating under an LCO.
2. System alignment requirements are complex, extensive, or not routine.
3. System operating conditions are dangerous OR P>150psig & T>200 F.
4. System contains radioactive gases or fluids.

(any 3/4 @ 1.0 ea.)

REFERENCE

ANO1 1000.27, Rev. 2, p. 9

ANSWER 8.10 (2.00)

a. equipment damage, b. danger (injury is XXX)
c. Operating License / TS, d. automatic trip
(4 answers @ 0.5 ea.)

REFERENCE

ANO1 1015.01, Rev. 13, p. 7

ANSWER 8.11 (1.00)

a. SS, b. STA, c. CR, d. 10 (4 answers @ 0.25)

REFERENCE

ANO1 1015.01, Rev. 13, p. 21

ANSWER 8.12 (3.50)

a. i.-3-SAE, ii.-1-NOUE, iii.-4-GAE, iv-2-Alert
b. 1. NOUE.
   2. Alert.
   3. SAE.

REFERENCE

ANO1 1903.10, Rev. 15, p. 2, 3, 5, 15, 28

NRC LICENSE EXAMINATION HANDOUT

EQUATIONS, CONSTANTS, AND CONVERSIONS

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

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

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

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

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

$I = I_o * e^{-u*x}$

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

$R/hr = 6 * CE/d^2$ 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-lb_f

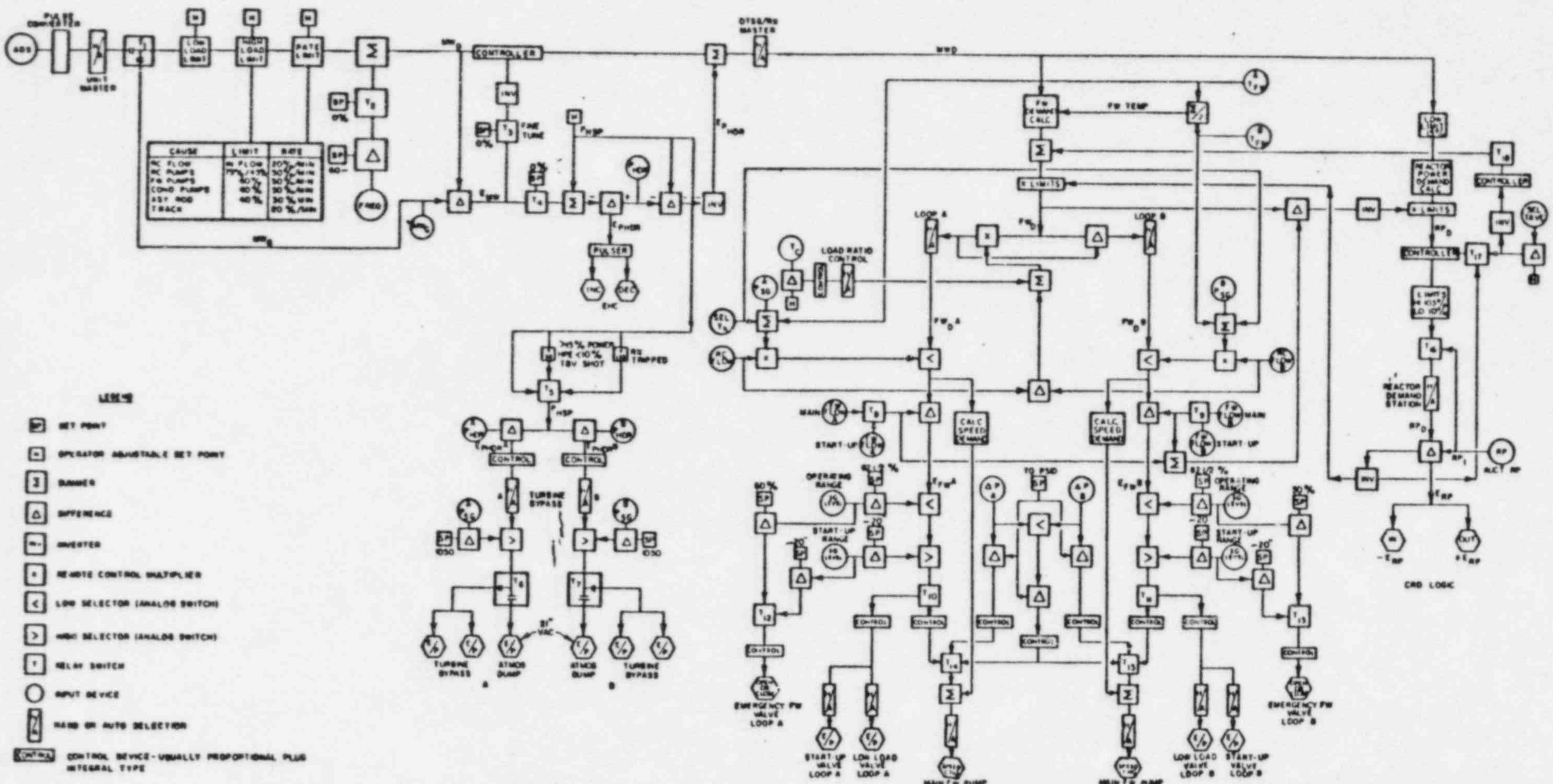

FIGURE 64.1

INTEGRATED CONTROL SYSTEM			
STM TITLE-INTEGRATED CONTROL SYSTEM			
STM No.	FIGURE	DATE	REV
STM-1-64	64.1	7-9-81	0