ENCLOSURE 1

COMMENTS ON THE REACTOR OPERATOR EXAMINATION

COMMENTS ON RO EXAMINATION
(Administered April 27, 1992)

1. **QUESTION** 002 (1.00)

Given the following:

- Turbine Runback from Underfrequency has reduced power to 60% (Overshoot on turbine controls)
- Rod Control System in manual for duration of runback
- 10.5 degree F Tavg-Tref mismatch

WHICH ONE (1) of the following rod speeds would be observed if the Rod Control Selector switch was taken to the AUTO position? (Figure 5 of SD-SO1-400, "Rod Control System" is attached)

a. 8.75 inches/min

b. 9.25 inches/min

c. 11.25 inches/min

d. 13.0 inches/min

ANSWER:

c

NRC REFERENCE: (TV)
1. SD-SO1-400, Rod Control System, Pg 6 of 52, Figure 5
2. L.P. 1XI203, Obj 1.3.2, Pg 26

SCE COMMENTS

FACILITY DISCUSSION: The graph removed from system description SD-SO1-400 which was attached to the test does not agree with the formula in system description SD-SO1-400. Choice "c" is correct using the formula, which is correct. Answer "d" is correct using the graph. The graphic artist when drawing the graph made a mistake and slipped the endpoint of the graph to the left one unit. The slope for Rod Speed rose from 5 in/min to 15 in/min from 8 to 11 degrees vs. the proper slope from 8 to 12 degrees.

REFERENCE MATERIAL: L.P. 1XI203, Rod Control System, Obj 1.3.2 , Pg 26, does not address this question clearly. Page 12, in lesson plan 1XI203 is the proper location to address this question, it discusses the fact that the rod speed is variable between 5" to 15"/min and provides a handout/TP entitled Figure 1-7. This figure is similar to the graph referenced in the system description but is drawn correctly.

SD-SO1-400, Rod Control System, Pg. 6, properly discussed the correct Tavg program, this is the choice that the NRC chose as correct. The NRC examiner did not check the accuracy of SD-SO1-400, Figure 5, but included it on the examination and this is what led to their being two correct answers.

The reference material provided by SCE was adequate to allow proper addressal of this question and answer.

SCE REFERENCE:
1. L.P. 1XI203, Obj 1.3.2, Pgs 12 and 26
2. L.P. 1XI203, Student Handout Figure 1-7
2. SD-SO1-400, Rod Control System, Pg 6 and Figure 5

SCE REQUESTED RESOLUTION: Accept both answers c and d

6.0 LESSON PRESENTATION

CONTENT	ACTIVITIES
b) Receives analog input from the RCPS proportional controller - signal is proportional and to the degree of Tave-Tref mismatch. This controls direction of travel and speed of the rods.	Sends output signal from 5" to 15" per minute. Show TP Figure 1-6 Rod Drive Control System.
c) Also receives an analog signal proportional to $P-P_{ref}$ and rate of change of nuclear flux from NIS PR 1208. This affects only the speed of the rods.	dT/dt is generated by the Differentiator. These have minimal affect on rod speed. Objective #1.3
d) Produces variable pulsed output through the master cycler to the slave cycler clutches.	Show TP Figure 1-7 Rod Speed vs. $T_{ave} - T_{ref}$.
e) Maximum pulse rate limited to 15 inches (40 pulses)/minute.	

6.0 LESSON PRESENTATION

CONTENT

ACTIVITIES

5) S/D Group Control Relays.

6) Control bank control relays.

7) SK1 relays (S/D MGC resistance circuits).

8) TR and CK1 relays (Control Group MGC resistance circuits).

III. General System Operations

Objective #1.2

A. Automatic Operation

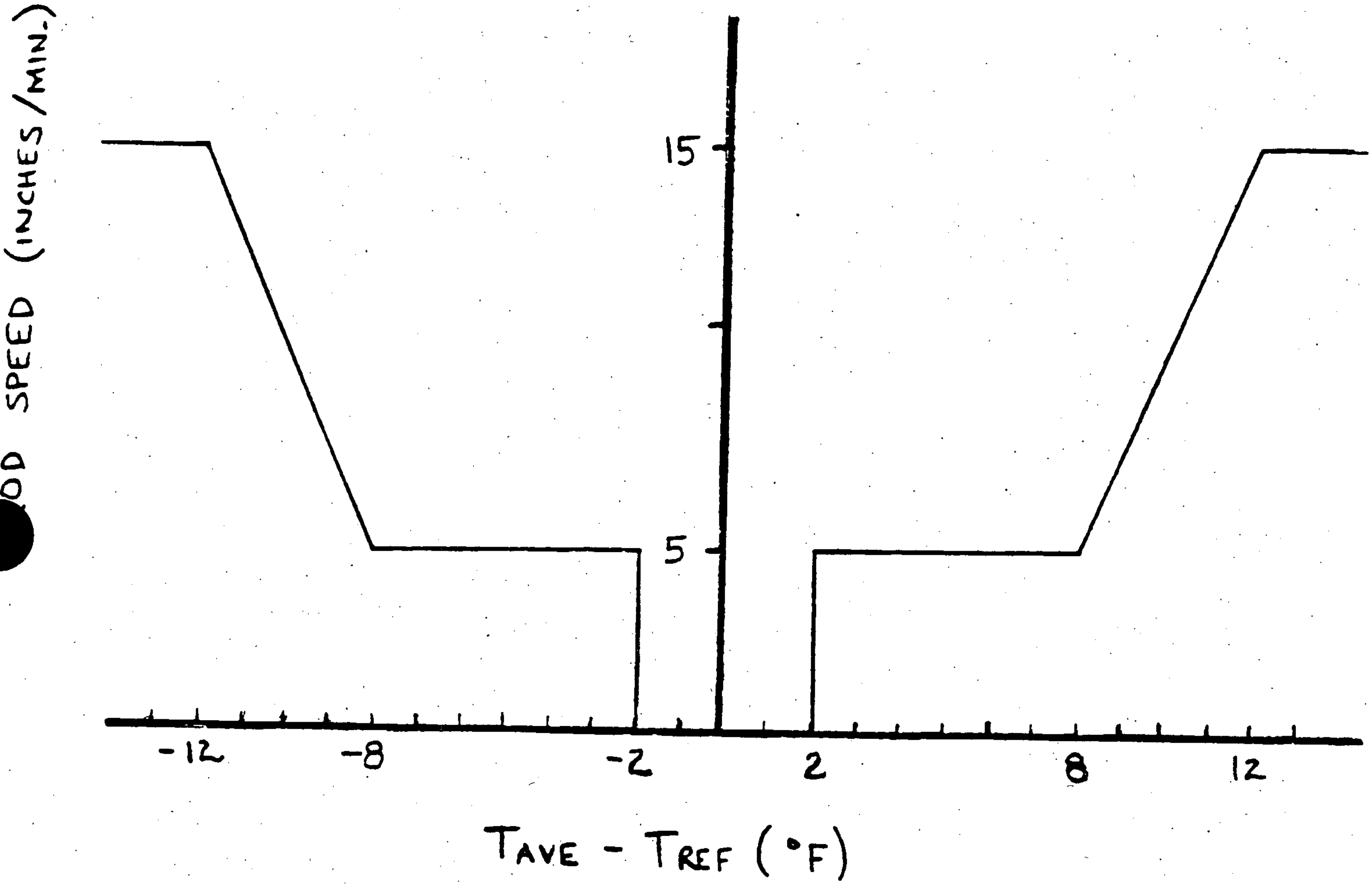
1. T_{ave} - T_{ref} exceeds ± 2°F; signal sent to pulser.

2. Pulser converts analog input to pulsed output voltage signals.

a. Pulse rate increases with T_{ave} - T_{ref} mismatch.

3. Pulses received by master cycler.

a. Master cycler distributes pulses among the control group slave cycler clutches.



1-7

"FOR TR
USE ONL

2.0 DESCRIPTION (Continued)

2.1.2 General Control Scheme (Continued)

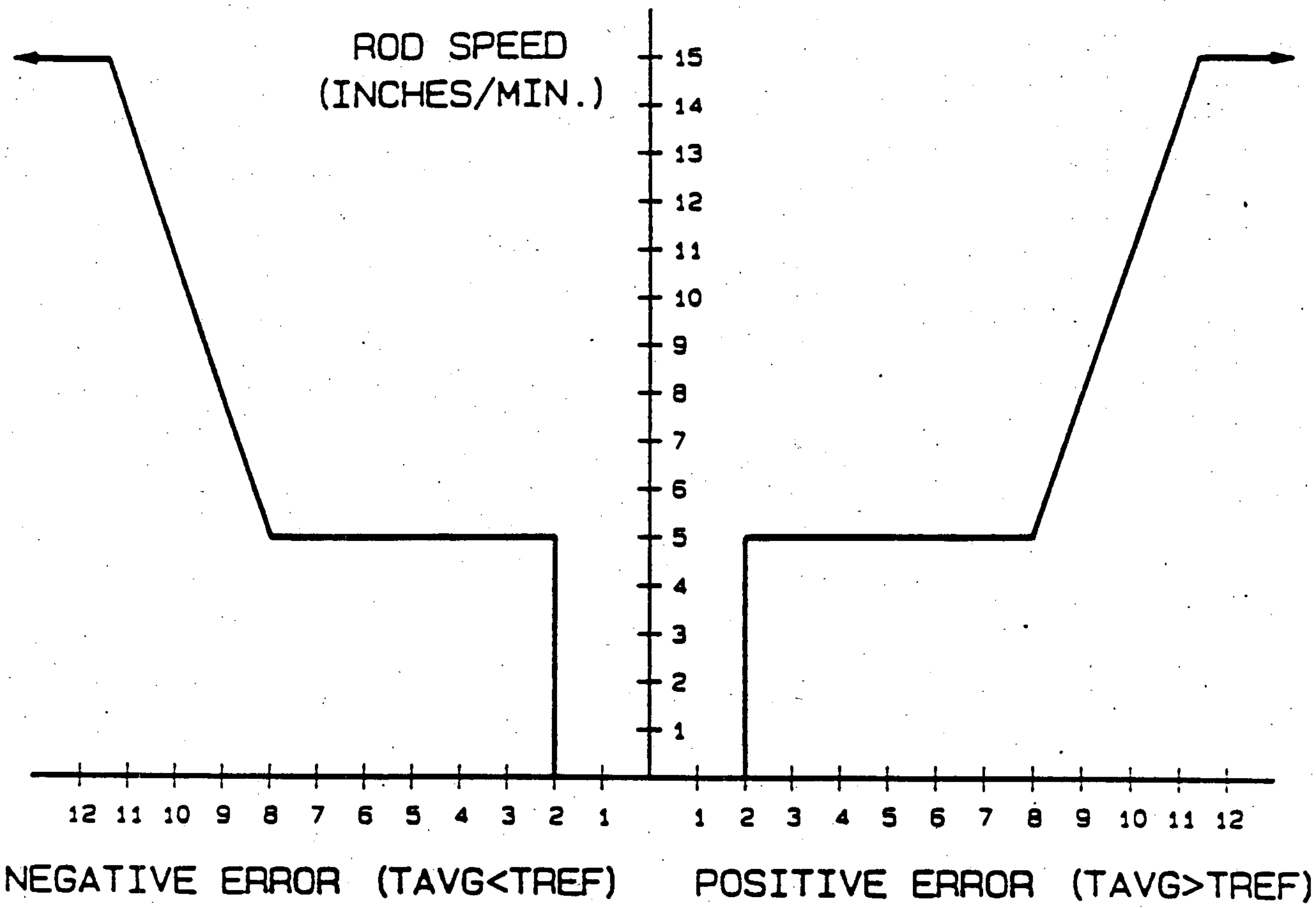
.1 (Continued)

The rods will start to move in or out as necessary at 5"/minute. Rod speed is maintained at 5"/minute from ± 2°F to ± 8°F mismatch. From ± 8°F mismatch to ± 12°F mismatch rod speed increases (2.5"/min./°F) from 5"/minute to 15"/minute which is its upper limit. Any mismatch greater than ± 12°F will still result in a rod speed of 15"/minute (Figure 5).

In manual operation the Control Rods receive their In or Out motion signal from the In-Hold-Out Switch on the J-console and their speed signal from manual speed controller HC-413 located in Rack R-1 behind the West Vertical Board. The speed signal is required to always be set at 15"/minute.

The group or bank to be moved is determined by the position of the Group Selector Switch and the Overlap Control Switch. Both switches are located on the J-console.

FIGURE 5: ROD CONTROL PROGRAM



2.0 DESCRIPTION (Continued)

2.1.2 **General Control Scheme** (Continued)

.1 (Continued)

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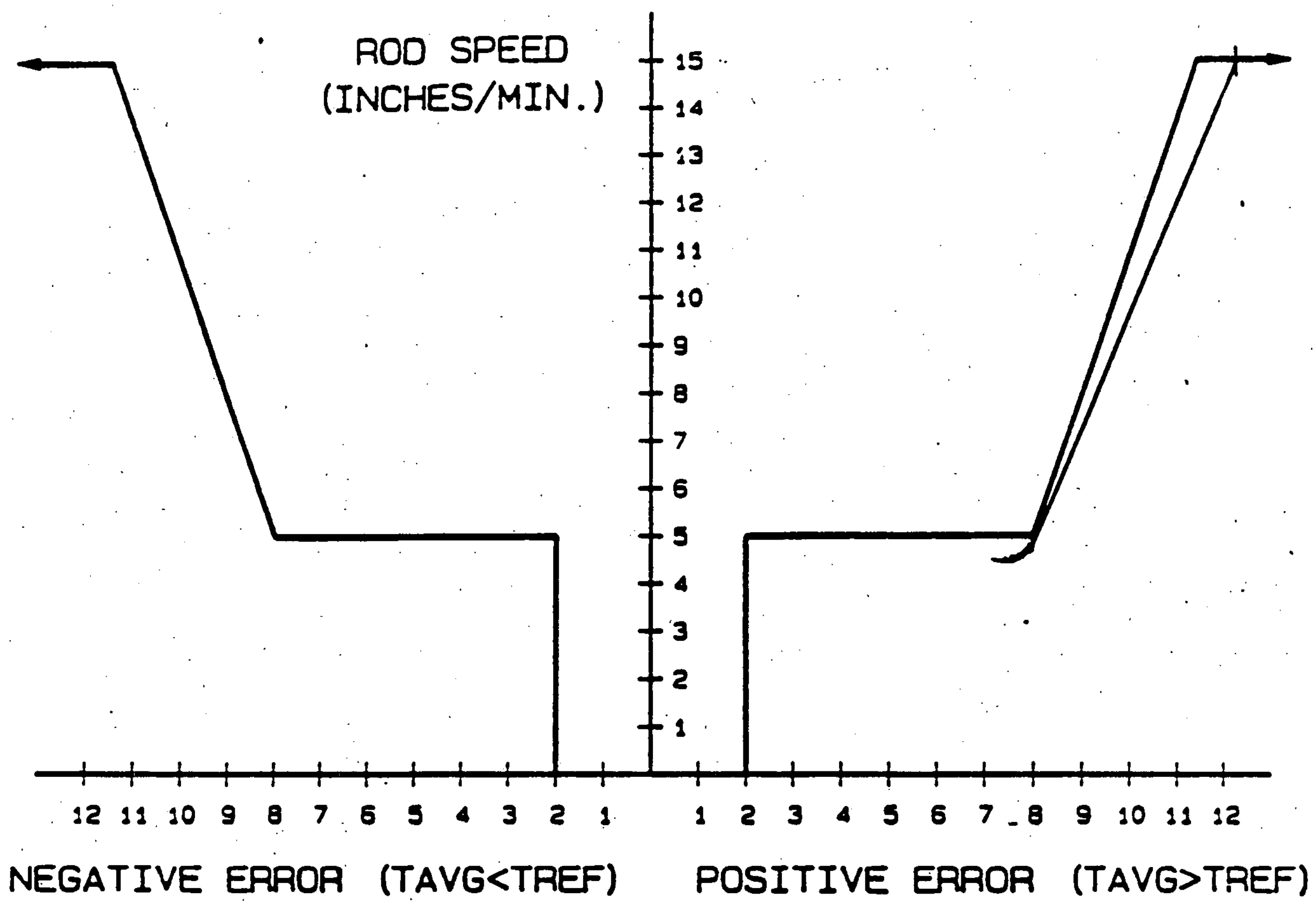
FIGURE 5: ROD CONTROL PROGRAM



2. **QUESTION** 003 (1.00)

Given the following:

- Power level 80%
- Pressurizer level is at program setpoint.
- Tavg recorder pens all indicate approximately 549 degrees F.
- Tavg/Tref are matched on recorder TR-405
- Rods start stepping in at high speed
- No turbine runback is in progress

WHICH ONE (1) of the following would cause these indications?

a. TM-407 - Avg Tave module to Rod Control loss of power.

b. TE-401A, Loop A hot leg temperature failed high.

c. TM-405 - Avg Tave summing computer failed low.

d. PT-415 - 1st Stage pressure failed high.

ANSWER:

a

NRC REFERENCE: (TV)
1. SO1-13-3, "Annunciator Response", Pg 13
2. L.P. 1XC206, Obj 2.2, Dwg RPS-1-7

SCE COMMENTS

FACILITY DISCUSSION: The sequence of the information presented in the initiating conditions resulted in confusion for the licensed operator candidates. The indications provided imply the rods start stepping in after all of the other information is provided. It does not state the rods are stepping in during the initial conditions but that they start stepping in. The setup of the question made it unclear as to whether the failure just occurred, with the conditions provided as the starting point or if the failure referenced was already present with the conditions provided.

Due to this confusion the students requested clarification as to which was the correct condition, were the conditions presented time 0, or after the failure. The response to the question was to consider the conditions time 0. In addition, the students are not expected to know the failure mode of all components in a given circuit, this caused some to question what the result would be if TM-407 were to loose power.

Answer "a" is correct. If TM-407 loses power, it fails such that Tavg appears high, thus resulting in rods moving in.

Answer "b" is correct. If the conditions are assumed to be at time 0. At time 0, with all systems working properly, the power level provided does not make a difference. Pressurizer level will be on program as stated in the initial conditions, Tavg recorder pens would all indicate approximately 549 degrees F, and Tavg/Tref would be matched on the recorder TR-405. Turbine runback would be irrelevant at this time, and as stated in the conditions, rods would have just started stepping in at high speed after the failure initiated.

The initial condition of pressurizer level at program setpoint further led the candidates to believe that the conditions provided in the question marked time 0 vs. some time after the initiation of the failure. Pressurizer level would not be at program setpoint if the failure had occurred prior to the conditions given. Pressurizer level and pressure are normally seen prior to actual temperature changes on the recorders, if the conditions provided represented a time after time 0, the pressurizer level should have been less then program level, due to RCS temperature decrease, resulting in system shrinkage and an outsurge from the pressurizer.

This question was not reviewed during the examination pre-review and had not been previously validated. The SCE reviewer believes it was added to the examination after the pre-review.

REFERENCE MATERIAL: L.P. 1XC206, Objective 2.2, Dwg. RPS-1-7, has no application to this question. Objective 2.2 states " Identify the physical location of all indicators, recorders, and controls for the Reactor Control System."

It is not an expectation that an operator know the failure mode of each part of a circuit in the plant, only that he/she can respond to the symptoms as they occur. To know that loss of power to Tavg module TM-407 would result in Tavg appearing high is not an expectation of the lesson referenced, and is not covered by any of the objectives in the referenced lesson plan, 1XC206. Drawing RPS-1-7 does not indicate/label TM-407 Tavg module and does not discuss or indicate how it will fail on a loss of power.

None of the references used by the NRC examiner were appropriate for this question, or could have provided the NRC examiner the information needed to correctly answer this question.

The reference material provided by SCE was adequate to allow addressal of this question and answer.

SCE REFERENCE:

To answer this question takes an integrated knowledge of the entire Reactor Control System and Nuclear Plant Fundamentals. There is no single set of references available that can be used to answer this question

1. 1542 sheet 102C

SCE REQUESTED RESOLUTION: Accept both a and b.

Question 5

1.0 OBJECTIVES:

Upon completion of this lesson, the student will be able to:

1.0 Relate knowledge of system purpose, function and design basis to an overview of the Reactor Control System.

1.1 Describe the purpose of the Reactor Control System.

1.2 List the functions of the Reactor Control System.

1.3 Describe the design features that enable the Reactor Control System to ensure that the safety limits will not be exceeded during power operation.

2.0 Apply knowledge of component type, location, function, principle of operation, design features and support systems to the ACO tasks of the Reactor Control System.

2.1 List the names and type of components used for inputs to the Reactor Control System.

2.2 Identify the physical location of all indicators, recorders and controls for the Reactor Control System.

2.3 For each RTD/Press. Xmtr. explain how it affects the Reactor Control System.

2.4 Explain how variable T_{ave}, Steam Dump Control and Shutdown Margin contribute to overall plant operation.

2.5 Explain how Reactor Control System supports the operation of the Reactor Protection System.

3.0 Apply knowledge of control type, purpose, principle of operation (in normal and abnormal modes), manipulations and actuations to the ACO tasks of the Reactor Control System.

3.1 List and describe the purpose of the Reactor Control System controls.

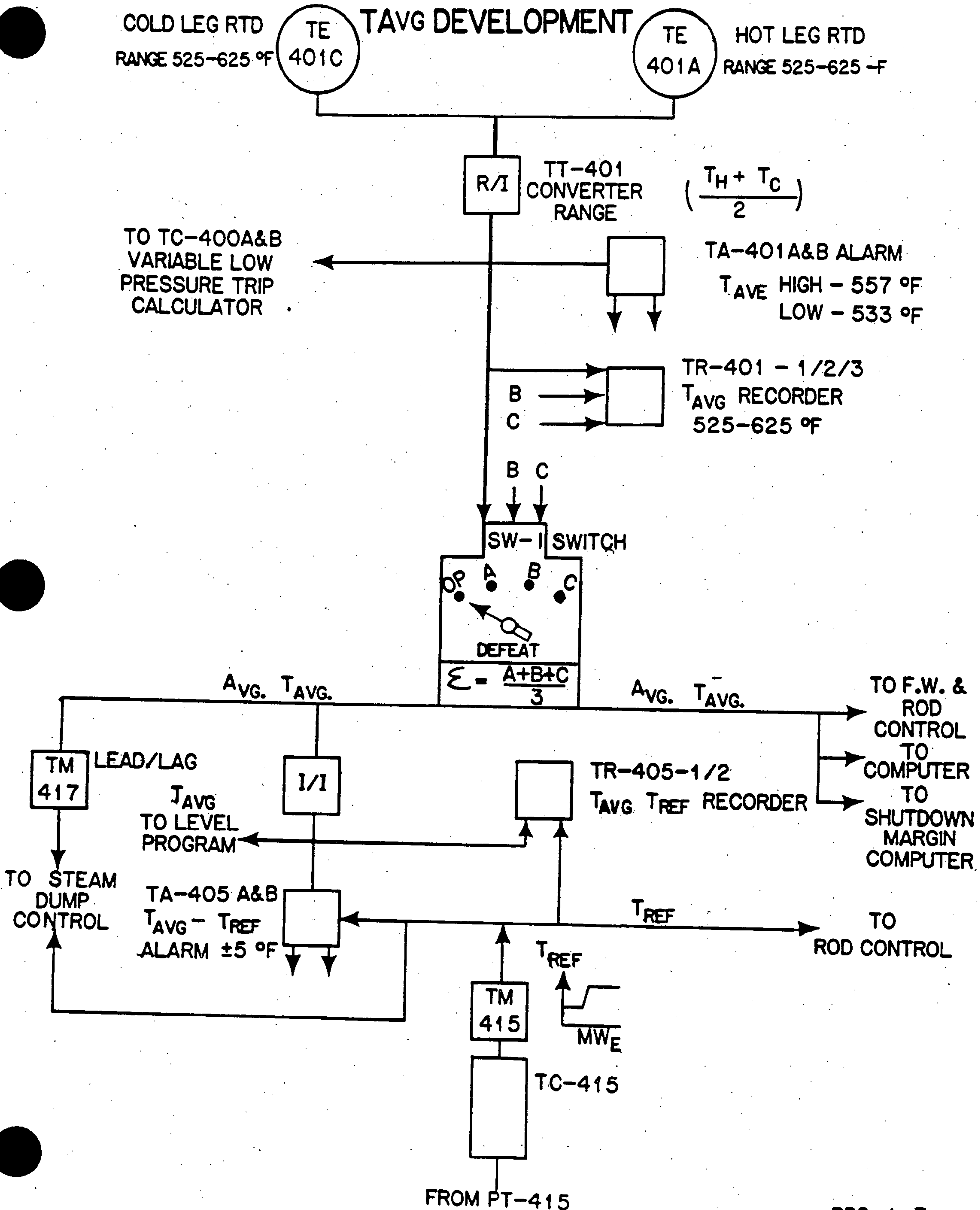
3.2 Explain how T_{REF}-AVE T_{AVE} control operates.

3.3 List and describe the inputs and outputs for the following Reactor Control System controls:

a. Loop T_{AVE} Defeat Switch.

b. Loop ΔT Defeat Switch.

1XC206


TAVG DEVELOPMENT
COLD LEG RTD
RANGE 525-625 °F
TE
401C
TE
401A
HOT LEG RTD
RANGE 525-625 °F
R/I
TT-401
CONVERTER
RANGE
$\left(\frac{T_H + T_C}{2}\right)$
TO TC-400A&B
VARIABLE LOW
PRESSURE TRIP
CALCULATOR
TA-401A&B ALARM
T_{AVE} HIGH - 557 °F
LOW - 533 °F
TR-401 - 1/2/3
T_{AVG} RECORDER
525-625 °F
B
C
B C
SW-I SWITCH
OP A B C
DEFEAT
$\Sigma = \frac{A+B+C}{3}$
AVG. TAVG.
AVG. TAVG.
TO F.W. &
ROD
CONTROL
TO
COMPUTER
TO
SHUTDOWN
MARGIN
COMPUTER
TM
417
LEAD/LAG
I/I
T_{AVG}
TO LEVEL
PROGRAM
TR-405-1/2
T_{AVG} T_{REF} RECORDER
TO STEAM
DUMP
CONTROL
TA-405 A&B
$T_{AVG} - T_{REF}$
ALARM ±5 °F
T_{REF}
TO
ROD CONTROL
T_{REF}
MW_E
TM
415
TC-415
FROM PT-415

RPS-1-7
RJM

ANIZATION

REACTOR PLANT NO. 2 ANNUNCIATOR

REACTOR COOL. HI TAVG LOOP C 9

1.0 Annunciator Window: 9

2.0 Setpoint: 557°F

3.0 Initiating Device: TA-421A-X

4.0 Applicability: MODES 1 - 3

5.0 Probable Cause:

(1) Rapid decrease in secondary steam demand.

6.0 Recommended Action:

CAUTION: With Avg T_{AVE} exceeding its limit of 553.5°F, Avg T_{AVE} shall be RESTORED to less than 553.5°F within 2 hours or reduce THERMAL POWER to less than 5% of RATED THERMAL POWER within the next 4 hours. (Reference #4)

1) VERIFY conditions and CHECK Loops "A" and "C" Tavg. Loop "C" Hot Leg and Cold Leg indication.

2) CHECK feedwater control.

3) MONITOR Control Rod Motion.

4) CHECK Loop "C" ΔT recorder and indication.

5) If signal is erroneous, REFER to S01-4-34 to defeat Loop "C" Tavg and variable low pressure trip for Loop "C".

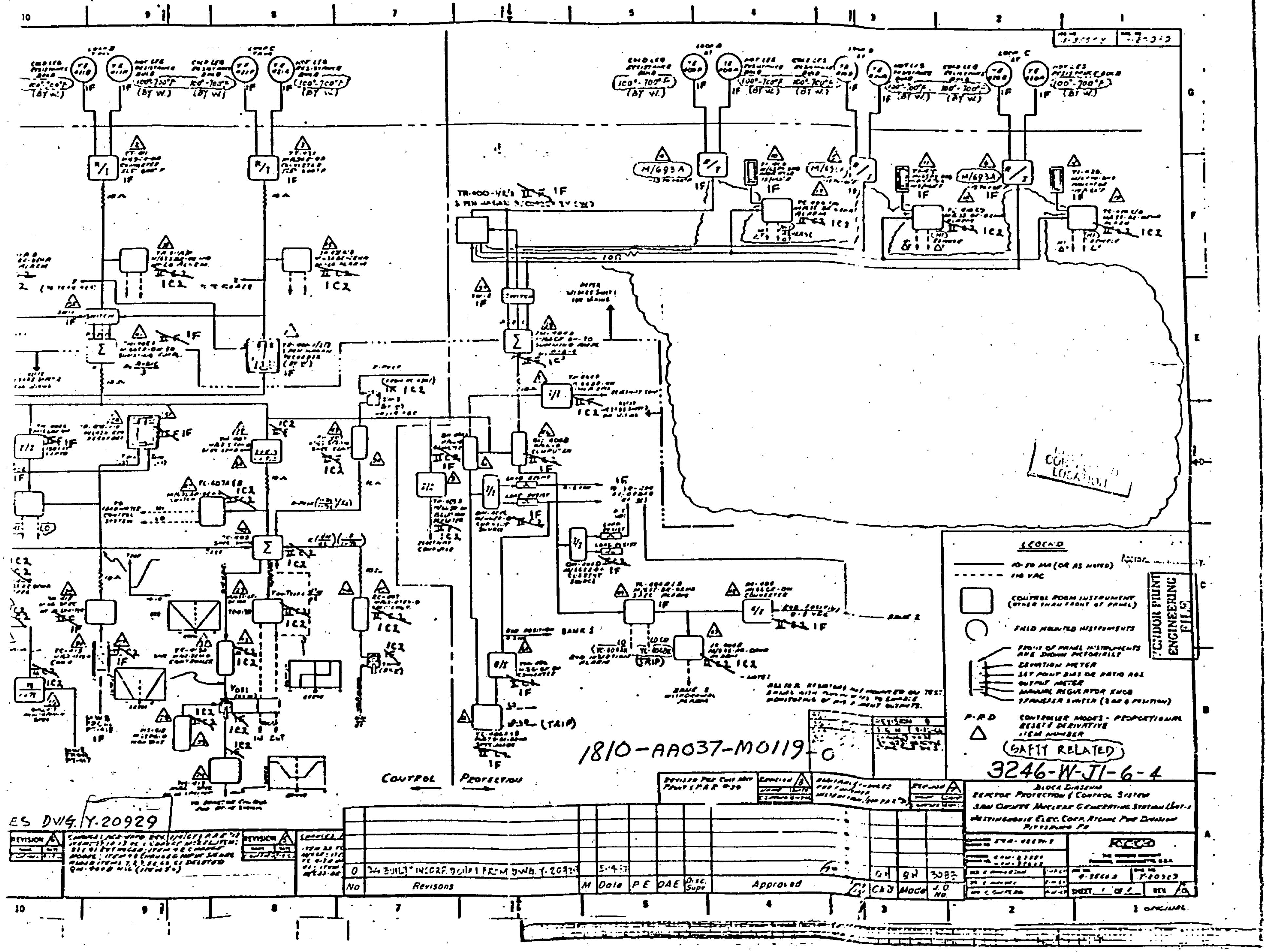
7.0 References:

1) Westinghouse Reactor Control and Protection System Manual

2) N1542 sh. 102C, "Reactor Protection"

3) S01-4-34, "Reactor Plant Instrumentation Operation"

4) Letter from B. Carlisle to M.P. Short and R.W. Waldo dated 2/25/91. Subject: Administrative Controls for Reduced Tave, SONGS 1.



CONTROL
PROTECTION
LEGEND
CONTROLLER MODES - PROPORTIONAL RESET & DERIVATIVE
ITEM NUMBER
SAFTY RELATED
3246-W-J1-6-4
1810-AA037-M0119-C
ES DWG. Y-20929
BLOCK DIAGRAM
REACTOR PROTECTION & CONTROL SYSTEM
SAN ONOFRE NUCLEAR GENERATING STATION UNIT-1
WESTINGHOUSE ELEC. CORP. ATOMIC PWR DIVISION
PITTSBURGH PA
No
Revisons
M
Date
PE
OAE
Disc. Supr
Approved
CAD
Mode
J.O. No.
ENGINEERING FILE
SHEET 1 OF 1
REV 0

4 209 a

3. **QUESTION** 004 (1.00)

WHICH ONE (1) of the following constitutes an "operable low temperature overpressure protection system", for low temperature RCP starts?

a. One PORV with a lift setting of less than or equal to 360 psig.

b. Two PORV's with a lift setting of less than or equal to 400 psig.

c. RHR relief valve RV-206 aligned to the RCS with a lift setting of less than or equal to 515 psig.

d. A Reactor Coolant System vent of greater than or equal to 1.75 square inches.

ANSWER:

d

NRC REFERENCE: (TV)
1. SO1-4-3, RCP Operation, Pg 11 of 31, Rev date 3/14/91
2. LP-1XA203, Rev 2, Objective 1.3.2, Pg 13

SCE COMMENTS

FACILITY DISCUSSION: The inclusion of the statement "for low temperature RCP starts" makes answer "d" an incorrect choice. Had the question stated "which of the following constitutes an operable overpressure protection system?", and not mentioned a low temperature RCP start, then d would be a correct answer. The requirement for a 1.75 square inch vent for overpressure protection is not related to a RCP start. A 1.75 square inch vent would prohibit a RCP start.

A reference used by the NRC, SO1-4-3, Section B, Pg 11, Precaution 4.3, is a general precaution statement placed in all procedures that relate to low RCS pressure operation. The procedure precaution makes the following statement:

4.3 <u>When</u> the RCS Temperature is ≤ 360 °F, <u>then</u> at least one of the following overpressure protection systems shall be OPERABLE: (Tech. spec. 3.20.A, Reference 2.1.2)

4.3.1 Two Power Operated Relief Valves (PORVS) with a lift setting of ≤ 465 psig <u>and</u> RHR relief valve RV-206 aligned to the RCS with a lift setting of ≤ 515 psig (Reference 2.4.6); <u>or</u>

4.3.2 A Reactor Coolant System vent(s) of ≥ 1.75 square inches.

The application of 4.3.2, will only be used when the RCS is depressurized. It can not be applied to the condition being addressed by this question, i.e. a low temperature RCP start.

The overpressure protection that would be in place when starting a RCP at low RCS pressure (≤ 400 psig), would be that referenced in SO1-4-3, Step 4.3.1, page 11. Two PORVs with a lift setting of ≤ 465 psig <u>and</u> RHR relief valve RV-206 aligned to the RCS with a lift setting of ≤ 515 psig.

To start a RCP per SO1-4-3, pg. 15, step 6.1.13, the RCS pressure must be 350 - 400 psig. Plant pressure can not be maintained at 350 - 400 psig with a 1.75 in or greater vent.

None of the other choices provided include all of the requirements for OMS and are also not related to the referenced low temperature RCP start.

REFERENCE MATERIAL: The NRC referenced LP-1XA203, Rev 2, Objective 1.3.2, Pg 13 as one of the source documents for their information. None of the answers provided as possible choices are supported by the referenced lesson plan. Objective 1.3.2 states "State the interlocks and administrative requirements to start on (sic) RCP." The referenced page does not have any discussion or implication about anything called a low temperature reactor coolant pump start. It has no discussion regarding any of the criteria provided in the question and its selection of answers. The LP simply states that the following is needed to start a RCP, lift pump on to upper thrust shoes, #1 seal $\Delta p > 275$ psi, #1 seal leakoff > .25 gpm, seal injection $\Delta P \approx 20"$ WG, no reverse ΔT of ≥ 5°F only with $T_c > 520°F$, and no overcurrent relay.

The NRC examination did not properly apply the precaution referenced by SO1-4-3, RCP Operation, Pg 11 of 31, Rev date 3/14/91.

The reference material provided by SCE was adequate to allow proper addressal of this question and answer.

SCE REFERENCE:

1. SO1-4.3, pages 11, 12, 13, and 15.

SCE REQUESTED RESOLUTION: Delete question; no correct answers provided.

Question 4

1.0 OBJECTIVES (Continued)

1.2.3 Describe the physical location of the following major RCP, Seal Injection/Leakoff System components: RCP, oil lift pump, seal water manifold & injection filters, seal manifold filter bypass MOV's, FCV's-1115A-F, PCV-1115A-C, CV-276, RV-2004, CV's 527 and 528, RV-289, CV-291, seal water return filter and heat exchanger, vapor seal head tank.

1.2.4 Describe the functions for all major components of the RCP and Seal Injection system.

1.2.5 Explain the operation of all major components of the RCP and Seal Injection system.

1.2.6 Describe the requirements for Component Cooling Water (CCW) of the RCP and Seal Injection/Leakoff System. List which RCP and Seal Injection Leakoff System components are cooled by CCW.

1.3 Discuss the name or type, location, function, operation, indication, applicable interlocks, requirements, and applicable normal/abnormal modes for the RCP and Seal Injection system controls.

1.3.1 Describe the physical location of the following RCP and Seal Injection system controls: RCP oil lift pumps, vapor seal head tank make up, MOV's 18 and 19, FCV's 1115A-F, PCV's-1115A-C, CV-276, CV's 527 and 528 and CV-291

1.3.2 State the interlocks and administrative requirements to start on RCP.

1.3.3 Explain the operating relationship between thermal barrier P and FCV-1115A-F controller response when the controllers are in auto.

1.3.4 Explain how the controllers for FCV-1115A-F would be manually manipulated to maintain proper seal injection flow.

1.4 Discuss the name or type, location, function, point of measurement and applicable alarms/setpoints for the instruments in the RCP and Seal Injection system.

1.4.1 List the names, type of indication (meter/ recorder) and purpose of the instruments used in the RCP and Seal Injection system.

1XA203 (59)

6.0 LESSON PRESENTATION

CONTENT	ACTIVITIES
.2 Operate opposite of RCP breaker position.	In 4KV room Neon indication
.4 Vibration Monitoring	Obj. 1.4.3
.1 Function - monitoring of equipment condition, possible early warning of impending failure.	
.2 Operation - channel indication and recorder located in rack behind west vertical board	
.5 Starting prerequisites/interlocks	Obj. 1.3.2, 1.6.2, 1.6.4
.1 Lift pump on, pressure light on (> 850 psig to upper thrust shoes)	Interlock
.2 #1 Seal $\Delta P > 275$ psi	Administrative
.3 #1 Seal Leak Off > .25 GPM	Administrative
.4 Seal Injection $\Delta P \approx 20"$ WC	Administrative
.5 NO reverse ΔT, of $\geq 5^\circ F$ only W/Tc > $520^\circ F$	Interlock
.6 No overcurrent (186 relay reset)	Interlock

SECTION B: RCP OPERATION

4.0 PRECAUTIONS (Continued)

4.4 When the RCS Temperature is ≤ 360°F, then at least one of the following overpressure protection systems shall be OPERABLE: (Tech. Spec. 3.20.A, Reference 2.1.2)

4.4.1 Two Power Operated Relief Valves (PORVs) with a lift setting of ≤ 465 psig and RHR relief valve RV-206 aligned to the RCS with a lift setting of ≤ 515 psig (Reference 2.4.5); or

NOTES: 1) One PORV blocked OPEN and its block valve OPEN meet the requirement of the 1.75 square inch vent. Two PORVs blocked OPEN and their block valves OPEN provide a 3.5 square inch vent. A removed Safety Valve provides a 5.4 square inch vent.

2) Tech. Spec. 3.20 Action C applies whenever RV-206 is inoperable or not aligned to the RCS.

4.4.2 A Reactor Coolant System vent(s) of ≥ 1.75 square inches.

4.5 When the RCS Temperature is ≤ 360°F, then the following conditions also apply: (Reference 2.4.5)

4.5.1 One Charging Pump Breaker shall be RACKED OUT.

4.5.2 A RCP shall not be started unless the requirements of Attachment 4 are satisfied.

4.6 When the RCS Temperature is ≤ 360°F, then the following charging flow limits apply (Reference 2.4.5):

NOTE: The following limits do not apply when the RCS Temperature is < 210°F, and the RCS is depressurized and vented through a 1.75 square inch vent(s) (Reference 2.4.5).

4.6.1 If FCV-1112 is not closed and disabled, and is not isolated, then the following limits apply:

.1 FCV-1112, Charging Flow Control Valve, shall be limited to less than 150 gpm flow.

.2 FCV-1115A, B, & C, RCP Seal Injection Flow Control Valves, shall be limited to less than 75 gpm total flow.

.3 FCV-1115D, E, & F, RCP Seal Injection Flow Control Valves, shall be MAINTAINED CLOSED.

SECTION B: RCP OPERATION

4.0 PRECAUTIONS (Continued)

4.6.2 If FCV-1112 is closed and disabled, or is isolated, then the following limits apply:

.1 Flow through FCV-1115A/D, B/E, C/F, RCP Seal Injection Flow Control Valves, shall be limited to < 150 gpm.

.2 Only one valve (FCV-1115D,E, or F) shall be used as a flowpath, and the other two valves shall be MAINTAINED CLOSED and DISABLED or ISOLATED

4.7 If the conditions of step 4.6 are not met, then the conditions shall be restored within 1 hour (Reference 2.4.5) and Operations Management shall be notified.

4.8 A Reactor Coolant Pump shall not be started with the RCS pressure ≤ 400 psig unless: (Tech. Spec. 3.1.2.I)

4.8.1 The Pressurizer water level is < 80% or

4.8.2 The potential for having developed reactor coolant system temperature gradients has been evaluated.

NOTE: There are several means available for determining that there is not a temperature differential of > 50°F between the secondary and primary systems with ≤ 400 psig primary system pressure. These methods may include but are not necessarily limited to the following: (Tech. Spec. 3.1.2 Basis) (See Attachment 5 for explanation of each of the following methods).

1) Converting steam line pressure indication into maximum temperature or steam generator fluid.

2) Tagging RCP switches with shutoff temperatures.

3) Assuring adequate time for temperature gradients to dissipate.

4) Filling steam generators with water of known temperature.

4.9 In Modes 5 & 6, Reactor Coolant Pumps should be rotated manually or electrically, as appropriate, once per two weeks to prevent damage to bearings, seals, etc. Station Technical should be notified to evaluate successive intervals (sequential 2 week periods) where this action could not or was not performed. (Reference 2.4.2 and 2.4.7) TCN

SECTION B: RCP OPERATION

4.0 PRECAUTIONS (Continued)

4.10 The following starting duty of the RCPs shall be observed:

4.10.1 Only one RCP is to be started at any one time.

4.10.2 If a RCP has failed to achieve full speed after an attempted start, a restart should not be attempted until the motor has been allowed to cool by standing idle for a period of not less than 30 minutes. After a RCP trip, an immediate restart is permitted if the motor has been running under normal load for at least 4 hours.

4.10.3 For each RCP, the number of starts will be limited to a maximum of 3 within a 2 hour period. A minimum idle period of 30 minutes for cooling will be observed between each attempted start. When 3 starts or attempted starts have been made within a 2 hour period, the fourth attempted start must not be made until the motor has been allowed to cool by standing idle for at least 1 hour.

4.11 Venting of RCP instrumentation should be performed only with the RCP stopped and FCV-1115 A, B and C in MANUAL.

4.12 During solid system operations, all RCPs shall be momentarily stopped when either RHR pump is started. A RCP restart shall be made only after evaluating the potential temperature gradients.

4.13 To prevent over stressing the thermal barrier heat exchanger's coils when the component cooling water is isolated from the thermal barrier heat exchanger, the maximum allowable thermal barrier heat exchanger pressure shall not exceed the primary side pressure by 225 psig.

4.14 Tests or maintenance activities that might affect Reactor Coolant System pressure shall not be performed during solid system operation.

4.15 If, during RCP operation, parameters associated with the RCP seem to be degrading, notification should be made to Station Management and Station Engineering for evaluation. (Reference 2.4.1)

4.16 When manually rotating a coupled RCP, the requirement to provide a minimum of .25 gpm RCP Seal leakoff flow may be waived provided the following conditions are met:

4.16.1 The RCS level is at least at the Reactor Vessel Flange, and

4.16.2 The RCP Seal Injection is aligned with the No. 1 RCP Seal leakoff flow directed to a floor drain, with visible drippage to the drain.

SECTION B: RCP OPERATION

6.0 INSTRUCTIONS (Continued)

6.1.7 VERIFY RCP motor oil system as follows:

.1 Oil level at mid range in upper and lower oil level sight glasses, and

.2 Oil collection system is intact, and

NOTE: Oil Collection System consists of drain pans, piping, fittings and oil collection tank.

.3 Shows no evidence of oil leakage.

6.1.8 VERIFY the Reactor Coolant Pump Oil Selector Valve is in the UPPER SHOES position.

6.1.9 ESTABLISH VCT pressure for running a RCP per SO1-4-7.

6.1.10 PLACE the RCP vibration recorder and the individual vibration modules in service for each RCP.

6.1.11 If any RCP instrumentation is out of service, then NOTIFY the SRO Operations Supervisor prior to starting that RCP.

6.1.12 If the observed Seal Injection System parameters are NOT as expected, then CHECK the system for proper alignment per SO1-4-36 Attachment 2, RCP Seal Water System Alignment, as a possible cause.

6.1.13 **VERIFY RCS pressure is 350 - 400 psig.**

CAUTION During solid system operations, all RCPs shall be momentarily stopped when either RHR pump is started.

CAUTION An RCP shall not be started with the RCS pressure $\leq$ 400 psig unless Pressurizer water level is < 80%, or the temperature difference between the secondary and primary systems is < 50°F. (Tech. Spec. 3.1.2.I) (Attachment 5 provides an explanation of 4 methods of determining the temperature difference).

6.1.14 If the RCS temperature is $\leq$ 360°F, then PERFORM the following:

.1 DETERMINE the Steam Generator to RCS ΔT per attachment 5.

.2 VERIFY the Steam Generator to RCS ΔT requirements of Attachment 4 are satisfied.

4. **QUESTION** 005 (1.00)

Given the following:

- Plant is in Mode 6
- RCP "B" motor is uncoupled from the pump.
- Loop "B" is full.
- Maintenance is working on the RCP "B" pump.

WHICH ONE (1) of the following prevents leakage of reactor coolant up the RCP shaft?

a. Pump shaft mates with the top of the thermal barrier assembly.

b. Seal Leakoff collects any RCS leakage up the shaft and directs it back to VCT.

c. Seal injection is maintained.

d. Nozzle dam installation.

ANSWER:

a

NRC REFERENCE: (TV)
1. L.P. 1XA203, Objective 1.2.4, Page 17

SCE COMMENTS

FACILITY DISCUSSION: System Description SD-SO1-300, page 21 discusses that the original design of the RCP incorporated a maintenance seal. If the system description is read further it states that work on the pump must be done at mid-loop. This is because the maintenance seal will no longer prevent leakage as stated in the question.

The current plant design and procedures do not allow the plant conditions stated in the question. In addition, the answer provided will not accomplish that which is stated, i.e. prevent leakage.

REFERENCE MATERIAL: The NRC reference to L.P. 1XA203, RCP and Seal Injection System, Objective 1.2.4, Page 17 does not agree with the question and the answer provided. The statement made in the L.P. is:

"Inside diameter of housing contains stellite overlayed seat to mate with similar seat on the outside of the shaft to act as a low pressure valve during seal section maintenance."

The objectives referenced as applicable to this question are 1.1.3 and 1.1.4, not 1.2.4 as referenced by the NRC Answer Key. Objective 1.2.4 states "Describe the functions for all major components of the RCP and Seal Injection system." The feature briefly mentioned in the L.P. is not considered a major component of the RCP and Seal Injection System. Objectives 1.1.3 and 1.1.4 reference discussions on how RCS leakage through the seals is controlled for various conditions. The discussion in the lesson plan does not state that the function of this seal design is to prevent leakage of reactor coolant up the RCP shaft during maintenance, it simply states that it acts as low pressure valve, not a low pressure cutoff valve.

Had the information assumed by the examination writer been cross checked with the system description SD-SO1-300, and the plant operating procedures, it would have been known that we can not perform maintenance on the RCP pump or it's seals with the associated loop full, we must be at mid-loop.

The reference material provided by SCE was adequate to allow proper addressal of this question and answer.

SCE REFERENCE:

1. SD-SO1-300, page 21

SCE REQUESTED RESOLUTION: Delete question; no correct answer provided.

2.0 DESCRIPTION (Continued)

2.2.4 Reactor Coolant Pump Hydraulic Section (Continued)

THERMAL BARRIER	
PURPOSE:	Cool reactor coolant flowing up through lower radial bearing and seals if injection flow is interrupted.
TYPE:	Crossflow
HEAT REMOVAL CRITERIA:	Prevent seal and bearing damage if seal injection flow is interrupted.
TUBE SIDE FLOW:	28 - 33 gpm by procedure
DESIGN TEMPERATURE INLET:	RCS 553°F CCW 100°F
DESIGN TEMPERATURE OUTLET:	RCS 150°F CCW 128°F
DESIGN PRESSURE:	2485 psig
DESIGN FEATURES:	Five Penetrations: Seal Injection Component Cooling Water Inlet Component Cooling Water Outlet ΔP High Side Tap ΔP Low Side Tap

Supporting Components and Indications

The Thermal Barrier lower housing inside diameter contains a stellite overlayed valve seat that mates with a similar seat on the outside diameter of the impeller and acts as a low pressure valve during seal maintenance with the system depressurized and drained to mid-loop. The thermal barrier is capable of cooling 6 gpm of reactor coolant flow through the seal during loss of seal injection flow.

ΔP Instrumentation provides indication in the Control Room on the North Vertical Board and controls Seal Injection and Leak-off valves, FCVs 1115 and PCVs 1115.

Question 5

1.0 OBJECTIVES (Continued)

1.2.3 Describe the physical location of the following major RCP, Seal Injection/Leakoff System components: RCP, oil lift pump, seal water manifold & injection filters, seal manifold filter bypass MOV's, FCV's-1115A-F, PCV-1115A-C, CV-276, RV-2004, CV's 527 and 528, RV-289, CV-291, seal water return filter and heat exchanger, vapor seal head tank.

1.2.4 Describe the functions for all major components of the RCP and Seal Injection system.

1.2.5 Explain the operation of all major components of the RCP and Seal Injection system.

1.2.6 Describe the requirements for Component Cooling Water (CCW) of the RCP and Seal Injection/Leakoff System. List which RCP and Seal Injection Leakoff System components are cooled by CCW.

1.3 Discuss the name or type, location, function, operation, indication, applicable interlocks, requirements, and applicable normal/abnormal modes for the RCP and Seal Injection system controls.

1.3.1 Describe the physical location of the following RCP and Seal Injection system controls: RCP oil lift pumps, vapor seal head tank make up, MOV's 18 and 19, FCV's 1115A-F, PCV's-1115A-C, CV-276, CV's 527 and 528 and CV-291

1.3.2 State the interlocks and administrative requirements to start on RCP.

1.3.3 Explain the operating relationship between thermal barrier P and FCV-1115A-F controller response when the controllers are in auto.

1.3.4 Explain how the controllers for FCV-1115A-F would be manually manipulated to maintain proper seal injection flow.

1.4 Discuss the name or type, location, function, point of measurement and applicable alarms/setpoints for the instruments in the RCP and Seal Injection system.

1.4.1 List the names, type of indication (meter/recorder) and purpose of the instruments used in the RCP and Seal Injection system.

(59)

CONTENT	ACTIVITIES
.5 Thermal Barrier	(Item #7) Obj. 1.1.4, 1.2.2, 1.2.4, 1.2.5
.1 Sandwiched between main flange (Item 10) and pump casing, sealed by gaskets (Item 17).	
.2 Heat exchanger - CCW flows through the tubes to cool RCS leakage up to the seals.	OBj. 1.2.6, 21 GPM design, 28-33 GPM per procedure CCW Flow, 5 GPM of RC flow
.3 This is only necessary if seal injection fails. It is necessary so that hot primary water does not damage the seals	Obj. 1.1.3
.4 Inside diameter of housing contains stellate overlayed seat to mate with similar seat on the outside of the shaft to act as a low pressure valve during seal section maintenance.	Obj. 1.1.3, 1.1.4
.6 Lower Radial Bearing	Obj. 1.1.2, 1.2.3, 1.2.4, 1.2.5 (Item #9)
.1 Two piece split housing and bearing cartridge.	
.2 Stellate and carbon	
.3 Water cooled and lubricated	
.4 Maximum operating design temperature is 300°F. A high bearing water temp. alarm set at 175°F.	RP #1, Window 66

5. **QUESTION** 006 (1.00)

Given the following:

Make-up to the RCS has increased to 95 gpm, and ONLY the following alarms are received:

"RC PUMP A NO. 1 SEAL LOW DELTA P"
"RC PUMP A NO. 1 SEAL LEAKOFF FLOW OFF NORMAL"
"RC PUMP A SEAL WATER HI FLOW"
"RC PUMP A NO. 2 SEAL HI FLOW"

WHICH ONE (1) of the following has occurred to the A RCP?

a. #1 seal has failed.

b. #1 and #2 seals have failed.

c. All the seals have failed.

d. Seal injection has failed.

ANSWER:

a

NRC REFERENCE: (JB)

1. Lesson Plan 1XA203, Obj. 7.5, page 14, para. 6.2.2.1.2
2. SONGS Exam Bank, Review Section 2, 2 of 15
3. System Description SD-SO1-300, Reactor Coolant Pump System, Page 27, step 3.2.2
4. SO1-13-4, "Reactor Plant No. 1 Annunciator", Windows 32, 52, 72

SCE COMMENTS

FACILITY DISCUSSION: The conditions/symptoms provided to determine the problem would be indicative of both answers "a" and "b". The only difference between a number 1 seal failure and number 2 seal failure is the amount of flow past the number 2 seal. A small increase in flow would take place in a number 1 seal failure, or a large increase in flow which would occur for a number 1 and 2 seal failure.

Procedure SO1-2.1-8, Section C, RCP Seal Trouble, does not differentiate between a failure of the number 1 seal and a combined failure of the number 1 and 2 seals. The procedure simply treats the symptoms. Once number 1 seal has failed, it is hard to determine if number 2 seal has failed also.

The only means to identify if the number 2 seal has also failed is to have some idea of the amount of relative leakage past the number 2 seal. For either a number 1 seal failure only or a number 1 and 2 seal, the operator would expect to see the "RC PUMP A NO.2 SEAL HI FLOW" alarm, which is typically used to determine a number 2 seal problem. This alarm can only be accurately used when there is a problem only with the number 2 seal. If there is a problem with the number 1 seal, then the alarm can indicate either a failed number 1 seal or a failure of the number 1 and number 2 seals. Therefore, both answers "a" and "b" should be correct. The question should not have asked for this type of discrimination.

The NRC Referenced SONGS Exam Bank, Review Section 2, 2 of 15. A search of the Examination Bank indicated that this question appears to have come from examination number 2228, review section 2, and was question number 2. The NRC examiner changed the question by adding a 95 GPM makeup and a statement that alarm "RC PUMP A NO. 2 SEAL HI FLOW" was present. The SONGS Examination had only the following alarms: "RC Pump A No. 1 Seal Low ΔP"; "RC Pump A No. 1 Seal Leakoff Flow Off Normal"; and "RC Pump A Seal Water Hi Flow". The NRC's addition of the additional alarm created the situation where their were two correct answers.

REFERENCE MATERIAL: The NRC Examination reference L.P. 1XA203, Obj 7.5, page 14, para. 6.2.2.1.2 does not support the conclusion provided by the examination writer.

The NRC Examination references L.P. 1XA203, Obj. 7.5, page 14, para 6.2.2.1.2. There is no objective 7.5 in this L.P., an assumption is made that the examiner made a typographical error, and meant to reference 1.7.5, which states "State the symptoms of a failure of #1 seal for a single RCP. Describe the immediate operator actions and identify the applicable AOI." The referenced page 14, and paragraph 6.2.2.1.2 are not referenced in the lesson plan as supporting this objective. The LP only discusses that the purpose of the floating ring seal is to limit leakage to 100 GPM @ 100 psid, in the event #1 seal is lost. None of the other conditions described in the plant conditions are described by this part of the lesson plan. The only reference in the question that appears to touch on this topic is that RCS makeup has increased to 95 gpm. This flowrate was not the referenced number in the lesson plan and does not discriminate between a number 1 seal failure and a number 1 and 2 seal failure.

The initial conditions referenced that there is a "RC PUMP A NO.2 SEAL HI FLOW" alarm annunciated. The same L.P. referenced by the NRC examiner L.P. 1XA203, page 23, 6.2.4.1.11.5 states "Abnormal - High level may be indication of failure of #2 seal or both #1 and #2 seals". High level in the Vapor Seal Head Tank referenced above is indicated by a "RC PUMP A NO.2 SEAL HI FLOW" alarm. This section of the L.P. does reference the appropriate objective of 1.7.5. This section supports again that there is not enough information provided to discriminate between a #1 seal failure only or a #1 and #2 seal failure.

The NRC Referenced SONGS Exam Bank, Review Section 2, 2 of 15, was inappropriately modified. See previous discussion.

The reference material provided by SCE was adequate to allow addressal of this question and answer.

SCE REFERENCE:

1. SD-SO1-300, Reactor Coolant Pump System, page 27, step 3.2.2.
2. SO1-2.1-8 page 21, step 7.
3. SO1-2.1-8 background document, section G, page 4 of 6.
4. SONGS Exam Bank, Review Section 2, 2 of 15
5. L. P. 1XA203,, Pg 23.

SCE REQUESTED RESOLUTION: Accept "a" and "b" as correct answers.

REACTOR COOLANT PUMP SYSTEM

3.0 OPERATION (Continued)

3.2 Abnormal or Emergency Operations

3.2.1 Loss of Seal Water Flow

Should seal water supply be interrupted, the Reactor Coolant Pumps can still be operated for short periods of time due to the thermal barrier. If seal injection flow is lost, the thermal barrier is capable of cooling normal seal leak-off flow indefinitely. Operating Instructions limit the amount of time Reactor Coolant Pumps are operated without seal injection flow because they are prone to failure when operating on unfiltered water.

3.2.2 Failure of Reactor Coolant Pump Seal

The Reactor Coolant Pumps seals are designed to provide redundancy in controlling leakage. If the Number 1 Seal were to fail, the Number 2 Seal is designed to take over as the main barrier to seal leakage. The Number 2 Seal is not designed to be operated in this mode for long periods and the Operating Instruction directs the operator to quickly reduce power and stop the RCP within 30 minutes of Number 1 Seal failure. If the Number 2 Seal should fail subsequent to the failure of Number 1 Seal, the injection flow and Number 2 Seal leak-off flow would increase until the differential pressure between the floating ring seal and Number 2 Seal leak-off line equals approximately 2050 psid. This pressure drop occurs at a flow rate of approximately 100 gpm. The design of the RCP thermal barrier is such that the maximum allowed No. 1 Seal flow rate is limited to 6 gpm to ensure adequate heat removal is achieved to prevent damage to temperature sensitive seal components such as internal O-rings. As a result, pump operation is limited to 30 minutes after Number 1 seal failure.

3.2.3 Transfer to Cold Leg Injection and Recirculation

After a LOCA or other transient has resulted in safety injection lowering RWST level to near or below 21%, safety injection will be terminated to provide recirculation of the spilled coolant from the containment sump back to the RCS and containment sprays. This is done by resetting the SI; stopping the Feed and SI pumps; placing seal supply flow controllers in manual and opening MOVs 18, 19, 356, 357 and 358; resetting charging pump lockout and starting the second charging pump; closing FCV-1112 and CV-304, then adjusting seal supply flow to obtain desired value. If instrument air is not available, control of FCV-1115 D, E and F is transferred to the West Vertical Board (FCV-1115 A, B and C fail OPEN). Recirculation Flow to each seal is indicated in the Main Control Room on FI-2114B, FI-2114C and FI-3114A. Once there is adequate recirculation volume, the Recirculation System is placed in service. (See SD-S01-580, "Safety Injection and Recirculation System".)

C. REACTOR COOLANT PUMP SEAL TROUBLE

OPERATOR ACTIONS

STEP — ACTION/EXPECTED RESPONSE — RESPONSE NOT OBTAINED

7 TAKE action as applicable per the following table: (Continued)

RCP SEAL TROUBLE ACTION TABLE	
SEAL INDICATION	SPECIFIED ACTION
SEAL WATER SUPPLY FLOW IS >12 GPM AND THERMAL BARRIER ΔP IS NORMAL. (MAY INDICATE FAILED NO.1 SEAL)	1) INCREASE SEAL WATER INJECTION WATER FLOW AS REQUIRED TO MAINTAIN NORMAL TEMPERATURE OF THE RCP WATER BEARING. 2) GO TO STEP 8.
NO.2 SEAL LEAKOFF FLOW HIGH (VAPOR SEAL HEAD TANK HIGH LEVEL)	1) ENSURE CLOSED, MAKEUP VALVE TO VAPOR SEAL HEAD TANK FOR AFFECTED RCP. 2) MONITOR AND LOG THE FOLLOWING PARAMETERS ONCE PER SHIFT ON ATTACHMENT 1 & 2, FOR ANY AFFECTED REACTOR COOLANT PUMP, : a. SEAL RETURN FLOW. b. SEAL SUPPLY FLOW. c. SEAL SUPPLY TEMPERATURE. d. SEAL LEAKOFF TEMPERATURE. e. ΔT BETWEEN SEAL SUPPLY AND SEAL RETURN. f. WATER BEARING TEMPERATURE. g. PUMP VIBRATION. h. INCREASE IN REACTOR COOLANT DRAIN TANK IN LEAKAGE PLUS NO. 1 SEAL LEAKOFF FLOW. 3) NOTIFY OPERATIONS MANAGEMENT AND STATION TECHNICAL FOR AN EVALUATION OF SEAL PERFORMANCE. 4) IF THE ΔT BETWEEN SEAL SUPPLY AND SEAL LEAKOFF EXCEEDS 50°F OR WATER BEARING TEMPERATURE INCREASES BY $\geq$ 5°F OR IF NO. 1 SEAL LEAKOFF PLUS THE INCREASE IN REACTOR COOLANT DRAIN TANK IN LEAKAGE IS $\geq$ 6 GPM, THEN PERFORM THE FOLLOWING: a. BEGIN LOAD REDUCTION TO < 10% POWER. b. AFTER LOAD REDUCTION, STOP THE AFFECTED REACTOR COOLANT PUMP. 5) IF THE ΔT BETWEEN SEAL SUPPLY AND SEAL LEAKOFF IS INCREASING AT GREATER THAN 5°F/MINUTE THEN PERFORM THE FOLLOWING, PRIOR TO EXCEEDING A MAXIMUM ΔT OF 100°F: (REFERENCE 4.4) a. IMMEDIATELY TRIP THE REACTOR. b. STOP THE AFFECTED REACTOR COOLANT PUMP. c. IMPLEMENT S01-1.0-10, REACTOR TRIP OR SAFETY INJECTION. 6) GO TO STEP 9.
RCS LEAKAGE TO CONTAINMENT HAS INCREASED, AN RCP HAS ERRATIC SEAL INDICATION AND VAPOR SEAL HEAD TANK LO LEVEL ALARM IS ACTIVE. (INDICATIVE OF NO.3 SEAL FAILURE)	1) GO TO STEP 8.

| TCN

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A note is provided as a reminder that closing PCV-1115A, B or C places the affected pump on the No.2 seal which is a limited duty seal. This should be taken into account when performing the evaluation in the following step. If seal water cannot be restored to the affected RCP, Step 8 provides direction for the SRO Operations Supervisor to initiate an evaluation for continued plant operation. This evaluation should include as a minimum the impact on continued plant operation, the actions required to isolate and repair any faulty components and any radiological hazards that may be involved.

If continued operation is safe, Step 9 provides direction to continue to monitor the affected RCP for a time period as established by Station Technical. If continued operation is not safe, then a unit shutdown is initiated. When reactor power is less than 10%, then the affected RCP is stopped and the operator is directed to Step 12. Step 10 is entered only if seal injection has been restored and directs the operator to verify that PCV-1115A, B and C are open. Any PCV found closed is opened. Step 11 gives direction to verify that No.1 seal leakoff flow is less than 5 gpm. If the No.1 seal leakoff flow for any pump is greater than or equal to 5 gpm, then its associated PCV is placed in automatic. Step 12 provides direction to initiate a LCOAR/EDMR if required. Step 13 directs the operator to initiate maintenance to correct the problem. Step 14 directs the operator to resume normal plant operation at the direction of the Shift Superintendent and then exits this instruction.

Section C, Reactor Coolant Pump Seal Trouble

The action steps provided in this section deal with Reactor Coolant Pump seal problems. Step 1 directs the operator to determine which pump is experiencing seal trouble. Step 2 directs the operator to verify No. 1 seal leakoff flow is less than 5 gpm. If leakoff flow is greater than 5 gpm, then action is taken to place the seal leakoff isolation valve in automatic. This will allow the valve to close on low thermal barrier differential pressure.

Step 3 directs the operator to determine if the seal water supply flow controller or control valve to the affected RCP has failed. Seal flow greater than 12 gpm and the high seal water supply alarm are indicative of this problem. If the seal water supply flow control valve is operating properly, the operator is directed to Step 5. Step 4 provides direction to place the flow controller in manual and adjust seal supply flow to establish a thermal barrier ΔP of 20"WC. Step 5 directs the operator to verify that the seal supply temperature is high, greater than 140°F. If seal supply temperature is less than 140°F, the operator is directed to Step 7. Step 6 provides action to be taken in an effort to lower the seal supply temperature. Step 7 directs the operator to the Action Table for RCP seal trouble. This table was developed to list the various combinations of seal problem indications that may be encountered and the actions to be taken for each and/or a kickout to a subsequent step to continue on with this instruction. The table is laid out to address problems with the No. 1 seal first, then the No. 2 seal, and then the No. 3 seal.

Question 6

1.0 OBJECTIVES (Continued)

1.6.3 Describe how changing seal return header pressure will affect the RCP Seal Injection/Leakoff System. Include changes in seal leakoff flows and temperatures.

1.6.4 Describe the operating precautions and limitations of the RCP and Seal Injection system per SO1-4-3.

1.6.5 Describe the monitoring requirements for the RCP and Seal Injection System per SO1-12.1-4.

1.6.6 Describe the use of procedure SO1-4-3 in starting RCP's and aligning Seal Injection for the different RCS conditions as stated in the procedure.

1.7 Discuss the abnormal condition response for an event including the RCP or Seal Injection system including recognition of symptoms event identification, immediate operator actions, applicable procedure use and a general recovery sequence.

1.7.1 Describe the conditions specified by SO1-4-3 that are necessary for opening CV-276 (#1 seal bypass)

1.7.2 Describe the manipulation and automatic operation of PCV's 1115A-C when a high seal leakoff flow condition exists. Include setpoint and conditions causing PCV's-1115A-C to close.

1.7.3 State the symptoms, immediate operator actions, applicable AOI and general recovery sequence for a complete or partial loss of RCP seal water supply.

1.7.4 Assuming FCV-1115A/D controller fails in automatic causing both FCV-1115A and D to shut, describe symptoms in the control room, immediate operator actions, applicable AOI and the general recovery sequence for this event.

1.7.5 State the symptoms of a failure of the #1 seal for a single RCP. Describe immediate operator actions and identify the applicable AOI.

1.7.6 Describe how additional seal leakoff flow may be provided, per SO1-4-3, when establishing seal injection and leakoff for initial RCP starting.

1XA2n3 (60)

CONTENT	ACTIVITIES
.6 Trips	Obj. 1.4.4
.1 Overcurrent(3) 50,51, ITH relays All in same case.	
.2 Undervoltage on bus	
.3 Coastdown (40% voltage if Frequency ≤ 58 cycles and 11A04 or 11B04 closed.	
.4 Undercurrent 137 160 AMPS 1 see (Sheared Shaft Event) Placed inservice 30 sec. after RCP bks closes.	
.5 SI	
.6 Loss of Voltage Auto Transfer	Discuss principle of mechanical seals.
.7 Over current 150-1 1760 AMPS 3 sec. TD (Seized Rotor Event) placed inservice 30 sec. after RCP bks close.	
6.2.2 Shaft Seal Section	Obj. 1.2.5
.1 Floating ring seal	Show TP #1, SEAL, Student Handout Page 6 (Item #63)
.1 Breakdown bushing	Obj. 1.1.2, 1.1.3
.2 In case #1 seal is lost, controls leakage 100 GPM @ 2100 psid	
.3 14 stationary and 14 floating rings.	

Exam #2228

(0.5) 2 You are the control room operator when the following alarms are received:

"RC Pump A No. 1 Seal Low ΔP"
"RC Pump A No.1 Seal Leakoff Flow Off Normal"
"RC Pump A Seal Water Hi Flow"

Based on these indications, what most likely has occurred?

a. #1 seal has failed for the A RCP.

b. #1 and #2 seals have failed on the A RCP.

c. The whole seal package for the A RCP has failed.

d. Seal injection has failed to the A RCP.

ANSWER: a. #1 seal has failed for the A RCP.

REFERENCE: 1XA203, Obj. 7.5

CONTENT	ACTIVITIES
.11 Vapor Seal Head Tank and Makeup Valves	Obj. 1.1.4, 1.2.2, 1.2.3, 1.2.4, 1.2.5, 1.3.1, 1.4.1, 1.4.2, 1.4.3, 1.4.4, 1.5.2, 1.7.5
.1 Location - containment	
.2 Function - accept leakoff from #2 seal and direct it to RCS drain tank - to provide necessary head to assure lubrication of #3 seal	
.3 Control- N.V.B. for makeup valves HCV 427 A, B, C supplied by #1 seal leak off	
.4 Indication - High Level Alarm - LC405,415,425 - Low level alarm - LC404,414,424	Hi - RP #1, Windows 72, 73, 74 + 5" Center Line Lo - RP #1, Windows 44, 45, 46 -5" Center Line
.5 Abnormal - High level may be indication of failure of #2 seal or both #1 and #2 seals. - Low level may be indication of #3 seal deterioration.	
.6 Power supplies - utility bus	

6. **QUESTION** 009 (1.00)

Given the following:

- Plant has been shutdown for 6 days.
- RCS temperature is 145 degrees F.
- RCS pressure is 340 psig.
- Pressurizer level is 62%.
- S/G's have been in wet layup for 2 days.
- Tag on Loop "A" RCP control switch has 190 degrees F written on it.
- SRO Ops Supervisor directs the RO to start the Loop "A" RCP.

WHICH ONE (1) of the following allows the start of the Loop "A" RCP.

a. Pressure is adequate for D/P across the #1 Seal.

b. Secondary temperature can be determined from steam pressure.

c. Adequate time for temperature gradients to dissipate has passed.

d. RCP shutoff temperature is within allowable value.

ANSWER:

d

NRC REFERENCE: (TV)
1. SO1-4-3, Reactor Coolant Pump Operation, Attachment 5
2. L.P. 1XA203, Obj. 1.6.6, Pg 28

SCE COMMENTS

FACILITY DISCUSSION: If the procedure referenced by the NRC is used it specifically prohibits starting an RCP with the conditions given in the question. In addition, the initial conditions given are not achievable with San Onofre procedures and requirements. The plant must be solid to achieve a pressure of 340 psig at a temperature of 145 degrees F. The 62% level is misleading.

This is a very complex scenario that requires the use of procedural attachments and curves. An operator should not be required to memorize curves and attachments, only know how to use them and the information contained in them. This would be a good open reference style question. It requires taking information using the procedures to perform calculations as directed and then taking the calculated information and conditions and applying this to a curve. There is no way that one could expect operators to have the curve memorized or the other details required to properly answer this question had it even provided a correct answer.

SO1-4-3, Page 11, Step 4.4 states: "When RCS Temperature is ≤ 360 °F, then, a RCP shall not be started unless requirements of Attachment 4 are satisfied." Based on Attachment 4, the stated conditions would not allow a RCP start, the conditions place the plant in the part of the attachment that is titled "RCP START FORBIDDEN". Per SO1-4-3, Page 15, a RCP could not be started for the following reasons:

a. Step 6.1.13 requires 350 - 400 psig, initial condition provided in the question was RCS pressure of 340 psig.

b. The Caution prior to Step 6.1.14 discusses the fact that if pressurizer level is less than 80% there are no temperature restrictions, it states:

   "A RCP shall not be started with RCS pressure ≤ 400 psig unless Pressurizer water level is < 80% **OR** the temperature difference between the secondary and primary systems is < 50°F."

   This OR situation is further discussed in SO1-4-3, RCP Operation, Page 12, steps 4.7, 4.7.1 and 4.7.2.

   This caution discriminates against the answer selected (d) as the correct answer on the answer key.

c. Step 6.1.14.2 would not allow a RCP per Attachment 4 discussed above.

REFERENCE MATERIAL: The NRC reference to L.P. 1XA203, Obj 1.6.6, Pg 28 does not support the answers provided by the NRC Examination.

Page 28 of L.P. 1XA203 does reference Obj. 1.6.6. The L.P. tells the instructor to utilize procedure SO1-4-3, Reactor Coolant Pump Operations, to discuss: 1. Precautions and limitations, 2. System Alignment, 3. Monitoring, 4. Seal bypass, 5. Abnormal conditions, and 6. Initial RCP starts. The lesson plan does not discuss any of the criteria addressed by the question.

From the above discussion it can be seen that if the NRC examination writer had properly read and interpreted SO1-4-3, the procedure he referenced, then the problem discussed would not have existed.

The reference material provided by SCE was adequate to allow addressal of this question and answer.

SCE REFERENCE:

1. SO1-4-3, Reactor Coolant Pump Operation, Pages 11, and 12; also pg 15, Steps 6.1.13, 6.1.14.2, Caution prior to step 6.1.14, and attachment 4.
2. Technical Specification 3.1.2.I.

SCE REQUESTED RESOLUTION: Delete question; no correct answer available.

SECTION B: RCP OPERATION

4.0 PRECAUTIONS (Continued)

4.3 When the RCS Temperature is ≤ 360°F, then at least one of the following overpressure protection systems shall be OPERABLE: (Tech. Spec. 3.20.A, Reference 2.1.2)

4.3.1 Two Power Operated Relief Valves (PORVs) with a lift setting of ≤ 465 psig and RHR relief valve RV-206 aligned to the RCS with a lift setting of ≤ 515 psig (Reference 2.4.6); or

NOTES: 1) One PORV blocked OPEN and its block valve OPEN meet the requirement of the 1.75 square inch vent. Two PORVs blocked OPEN and their block valves OPEN provide a 3.5 square inch vent. A removed Safety Valve provides a 5.4 square inch vent.

2) Tech. Spec. 3.20 Action C applies whenever RV-206 is inoperable or not aligned to the RCS.

4.3.2 A Reactor Coolant System vent(s) of ≥ 1.75 square inches.

4.4 When the RCS Temperature is ≤ 360°F, then the following conditions also apply: (Reference 2.4.6)

4.4.1 One Charging Pump Breaker shall be RACKED OUT.

4.4.2 A RCP shall not be started unless the requirements of Attachment 4 are satisfied.

4.5 When the RCS Temperature is ≤ 360°F, then the following charging flow limits apply (Reference 2.4.6):

NOTE: The following limits do not apply when the RCS Temperature is < 210°F, and the RCS is depressurized and vented through a 1.75 square inch vent(s) (Reference 2.4.6).

4.5.1 If FCV-1112 is not closed and disabled, and is not isolated, then the following limits apply:

.1 FCV-1112, Charging Flow Control Valve, shall be limited to less than 150 gpm flow.

.2 FCV-1115A, B, & C, RCP Seal Injection Flow Control Valves, shall be limited to less than 75 gpm total flow.

.3 FCV-1115D, E, & F, RCP Seal Injection Flow Control Valves, shall be MAINTAINED CLOSED.

SECTION B: RCP OPERATION

4.0 PRECAUTIONS (Continued)

4.5.2 *If* FCV-1112 is closed and disabled, *or* is isolated, *then* the following limits apply:

.1 Flow through FCV-1115A/D, B/E, C/F, RCP Seal Injection Flow Control Valves, shall be limited to < 150 gpm.

.2 Only one valve (FCV-1115D,E, or F) shall be used as a flowpath, and the other two valves shall be MAINTAINED CLOSED and DISABLED *or* ISOLATED

4.6 *If* the conditions of step 4.5 are not met, *then* the conditions shall be restored within 1 hour (Reference 2.4.6) *and* Operations Management shall be notified.

4.7 A Reactor Coolant Pump shall not be started with the RCS pressure ≤ 400 psig unless: (Tech. Spec. 3.1.2.I)

4.7.1 The Pressurizer water level is < 80% or

4.7.2 The potential for having developed reactor coolant system temperature gradients has been evaluated.

NOTE: There are several means available for determining that there is not a temperature differential of > 50°F between the secondary and primary systems with ≤ 400 psig primary system pressure. These methods may include but are not necessarily limited to the following: (Tech. Spec. 3.1.2 Basis) (See Attachment 5 for explanation of each of the following methods).

1) Converting steam line pressure indication into maximum temperature of steam generator fluid.

2) Tagging RCP switches with shutoff temperatures.

3) Assuring adequate time for temperature gradients to dissipate.

4) Filling steam generators with water of known temperature.

SECTION B: RCP OPERATION

6.0 INSTRUCTIONS (Continued)

6.1.7 VERIFY RCP motor oil system as follows:

.1 Oil level at mid range in upper and lower oil level sight glasses, and

.2 Oil collection system is intact, and

NOTE: Oil Collection System consists of drain pans, piping, fittings and oil collection tank.

.3 Shows no evidence of oil leakage.

6.1.8 VERIFY the Reactor Coolant Pump Oil Selector Valve is in the UPPER SHOES position.

6.1.9 ESTABLISH VCT pressure for running a RCP per S01-4-7.

6.1.10 PLACE the RCP vibration recorder and the individual vibration modules in service for each RCP.

6.1.11 If any RCP instrumentation is out of service, then NOTIFY the SRO Operations Supervisor prior to starting that RCP.

6.1.12 If the observed Seal Injection System parameters are NOT as expected, then CHECK the system for proper alignment per S01-4-36 Attachment #2, RCP Seal Water System Alignment, as a possible cause. TCN

6.1.13 VERIFY RCS pressure is 350 - 400 psig.

CAUTION During solid system operations, all RCPs shall be momentarily stopped when either RHR pump is started.

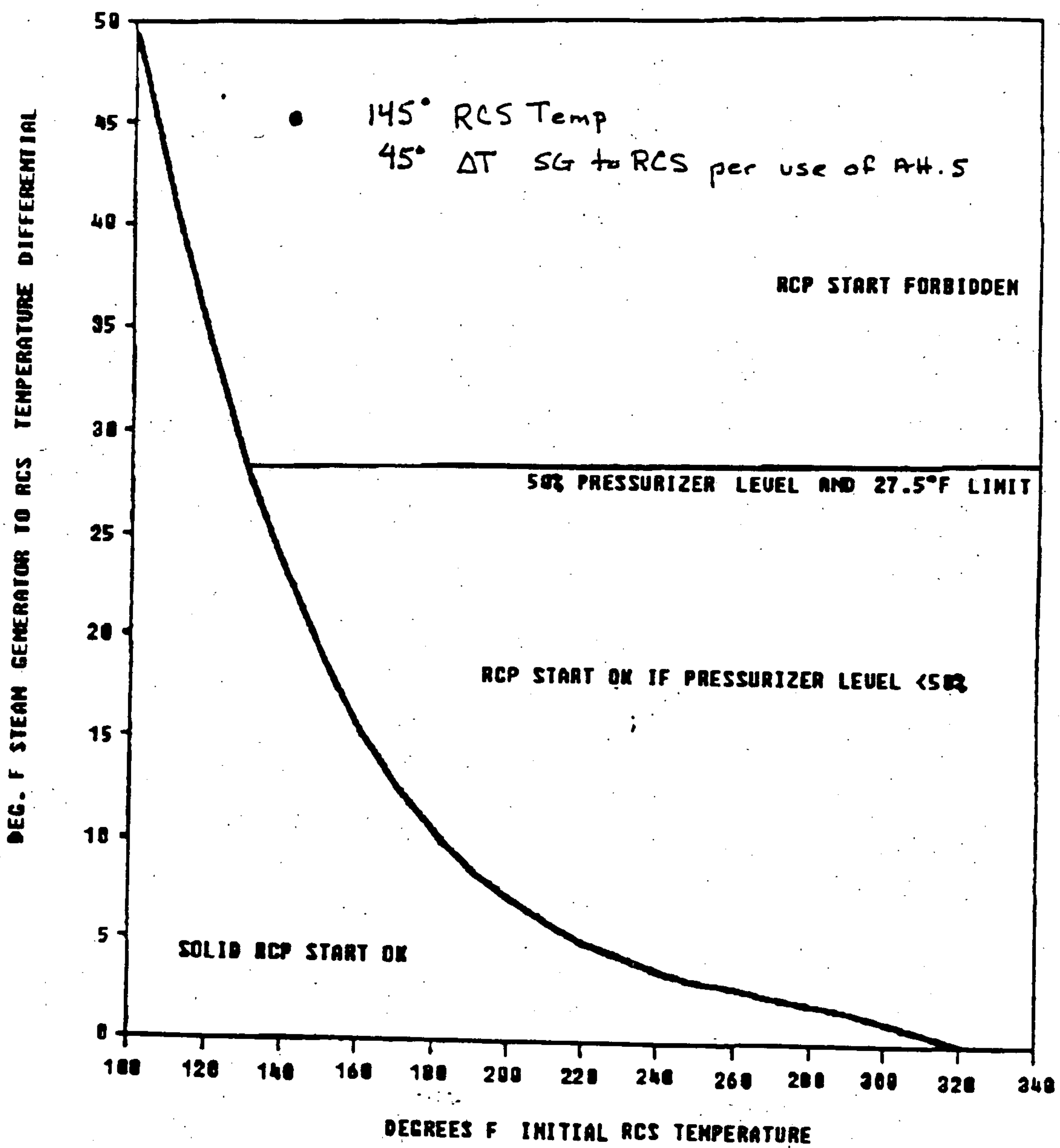
CAUTION An RCP shall not be started with the RCS pressure ≤ 400 psig unless Pressurizer water level is < 80%, or the temperature difference between the secondary and primary systems is < 50°F. (Tech. Spec. 3.1.2.I) (Attachment 5 provides an explanation of 4 methods of determining the temperature difference).

6.1.14 If the RCS temperature is ≤ 360°F, then PERFORM the following:

.1 DETERMINE the Steam Generator to RCS ΔT per attachment 5.

.2 VERIFY the Steam Generator to RCS ΔT requirements of Attachment 4 are satisfied.

RCP START ALLOWABLE STEAM GENERATOR TO RCS DELTA-T



DETERMINING TEMPERATURE GRADIENTS

1) Converting Steam Line Pressure Indication into Equivalent Temperature: The maximum temperature of the fluid in the steam generator can be converted from the steam line pressure. For example, if steam line pressure is ambient, it must be assumed that the temperature of the fluid in the steam generator is 212°F unless another method would support a lower temperature. For higher pressures, the temperature must be assumed to be equal to the saturation temperature at that pressure. This is one method that allows a quick conservative determination to be made regarding the acceptability of starting an RCP. (Section B Reference 2.4.4)

2) Tagging Reactor Coolant Pump Switches with Shutoff Temperatures: During cooldown to cold shutdown, the reactor coolant pumps are normally kept running until the RCS and steam generator metal temperatures have had time to equalize after reaching the desired cooldown temperature. Once this condition has been established (about 1 hour*), yellow caution tags with final RCS temperature are placed at each switch. This is an indication of steam generator temperature when the pumps were last run. The only way for a > 50°F temperature gradient to develop under these conditions is to heat the RCS to a higher temperature (which could also heat the steam generators), or to cool the RCS > 50°F below the temperature at which the pumps were stopped. Before starting an RCP the operator would merely check the tagged temperature on the RCP switch and determine whether any recent RCS temperature excursions exceeded the tagged temperature by > 50°F, or if the current RCS temperature is more than 50°F lower than the tagged temperature. By doing this it can be assured that the differential temperature is < 50°F and a pump can be safely started. (Section B Reference 2.4.4)

3) Assuring Adequate Time for Temperature Gradients to Dissipate: During extended periods (on the order of at least one week*) of shutdown without any temperature transient in the primary and secondary, the RCS and the secondary side temperatures will equalize. Under these circumstances of extended periods with no temperature transients, an RCP can be safely started. It should also be noted that an RCP can be stopped at any time under water solid conditions and restarted within a short period of time if the cooldown rate has not been too rapid to create a > 50°F temperature differential. For example, when going onto RHR, the RCP's are stopped when an RHR pump is started. If the cooldown rate at this time is 50°F per hour, then the pumps could be restarted within one hour without the possibility of having developed temperature gradients. If more than an hour elapsed since the pumps were secured, then an alternate means would be required to determine the maximum temperature gradient. (Section B Reference 2.4.4)

* These time periods are not based on analysis done to determine RCS and steam generator metal temperatures, rather the time periods are based on conservative engineering judgement.

Question 9

1.0 OBJECTIVES (Continued)

1.6.3 Describe how changing seal return header pressure will affect the RCP Seal Injection/Leakoff System. Include changes in seal leakoff flows and temperatures.

1.6.4 Describe the operating precautions and limitations of the RCP and Seal Injection system per SO1-4-3.

1.6.5 Describe the monitoring requirements for the RCP and Seal Injection System per SO1-12.1-4.

1.6.6 Describe the use of procedure SO1-4-3 in starting RCP's and aligning Seal Injection for the different RCS conditions as stated in the procedure.

1.7 Discuss the abnormal condition response for an event including the RCP or Seal Injection system including recognition of symptoms event identification, immediate operator actions, applicable procedure use and a general recovery sequence.

1.7.1 Describe the conditions specified by SO1-4-3 that are necessary for opening CV-276 (#1 seal bypass)

1.7.2 Describe the manipulation and automatic operation of PCV's 1115A-C when a high seal leakoff flow condition exists. Include setpoint and conditions causing PCV's-1115A-C to close.

1.7.3 State the symptoms, immediate operator actions, applicable AOI and general recovery sequence for a complete or partial loss of RCP seal water supply.

1.7.4 Assuming FCV-1115A/D controller fails in automatic causing both FCV-1115A and D to shut, describe symptoms in the control room, immediate operator actions, applicable AOI and the general recovery sequence for this event.

1.7.5 State the symptoms of a failure of the #1 seal for a single RCP. Describe immediate operator actions and identify the applicable AOI.

1.7.6 Describe how additional seal leakoff flow may be provided, per SO1-4-3, when establishing seal injection and leakoff for initial RCP starting.

1XA203 (61)

6.0 LESSON PRESENTATION

CONTENT	ACTIVITIES
6.2.5 System Operation	
.1 Normal System Operation	
.1 Refer to SO1-4-3, Reactor Coolant Pump Operations	
.1 Precautions and limitations	Obj. 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.6.5, 1.6.6, 1.6.7, 1.7.1, 1.7.6
.2 System alignment	
.3 Monitoring	
.4 Seal bypass	
.5 Abnormal conditions	
.6 Initial RCP Start	
.2 Abnormal System Operation	Obj. 1.3.5, 1.7.2, 1.7.3, 1.7.4, 1.7.5
.1 Refer to SO1-2.1-7, Loss of Reactor Coolant Pump Motor Cooling SO1-2.1-8, Reactor Coolant Pump Seal Trouble	
.1 High seal leakoff flow	
.2 Complete or partial loss of RCP seal water supply	

H. During MODE 5 with reactor coolant loops not filled, the following specifications shall apply:

1. Two RESIDUAL HEAT REMOVAL (RHR) TRAINS shall be OPERABLE* and at least one RHR TRAIN shall be in operation**.

2. With less than the above required RHR TRAINS OPERABLE, immediately initiate corrective action to return the required RHR TRAINS to operable status as soon as possible.

3. With no RHR TRAIN in operation, suspend all operations involving a reduction in boron concentration of the reactor coolant system and immediately initiate corrective action to return the required RHR TRAIN to operation.

I. A reactor coolant pump shall not be started with the RCS pressure $\leq$ 400 psig unless:

1. the pressurizer water level is less than 80%, or

2. the potential for having developed reactor coolant system temperature gradients has been evaluated.

<u>BASIS</u>:

One pressurizer safety valve is sufficient to prevent over-pressurizing when the reactor is subcritical, since its relieving capacity is greater than that required by the sum of the available heat sources, i.e., residual heat, pump energy and pressurizer heaters.

Prior to reducing boron concentration by dilution with make up water either a reactor coolant pump or a residual heat removal pump is specified to be in operation in order to provide effective mixing. During boron injection, the operation of a pump, although desirable, is not essential. The boron is injected into an inlet leg of the reactor coolant loop. Thermal circulation which exists whenever there is residual heat in the core and the reactor coolant system is filled and vented, will cause the boron to flow to the core.

* One RHR TRAIN may be inoperable for up to 2 hours for surveillance testing provided the other RHR TRAIN is operable and in operation.

** The RHR pump may be de-energized for up to one hour provided (a) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (b) core outlet temperature is maintained at least 40°F below saturation temperature.

7. **QUESTION** 012 (1.00)

WHICH ONE (1) of the following occurs at "DIESEL GENERATOR BREAKER CLOSED +2 (TWO) SECONDS" after receipt of a SIS/LOP signal?

a. TCV-601 A & B, CCW to RHR Heat exchangers close.

b. Sequencer output to Load Group "B".

c. Feedwater pump recirc to condenser closes.

d. CCW pumps start.

ANSWER:

c

NRC REFERENCE: (TV)
1. L.P. 1XC207, Obj 3.8.3, Pg 20
2. SO1-4-46, Safety Injection System Operation"
3. Drawings 5149178 through 5149182

SCE COMMENTS

FACILITY DISCUSSION: This question is requesting detailed circuitry knowledge that is unexpected of an operator without the use of references. It is true that allowed to use references, the operator would be able to go to the prints and determine which loads come off of which load groups for the sequencer. However, there are far too many loads to expect that the operator would have each of these load groups memorized.

To have memorized the individual actions that occur for each load group and the start times of each load group associated with the sequencer during a SIS, SIS/LOP, or a LOP is not an expected knowledge at San Onofre. To know what is going to occur to the plant and how each component is expected to operate, i.e should a pump start or stop, or should a valve open or close during these sequencer signals is the expected knowledge.

The wording for answer "c" states that "Feedwater pump recirc to condenser closes" at +2 seconds. The sequencer signal to the valve is generated at that time.

The Feedwater pump recirc to condenser valves are also operated based on the position of SI Valves HV853A and HV853B. HV853A and HV853B receive a signal to operate at time zero (0). As these valves move off of their closed seat the feedwater recirc valves (CV36 and 37) are operated. This contact is in parallel with the sequencer contacts, the sequencer contacts are a backup to the limit switches associated with SI Valves HV853A and HV853B.

As can be seen if all is working properly the feedwater pump recirc to condenser valves will start to close slightly after time zero, and not at DG Breaker Close +2 seconds.

REFERENCE MATERIAL: The objective referenced by the NRC examiner 3.8.3 states "Explain how the following components respond to SIS, LOP, or SISLOP: SISLOP 4KV and 480V Lockouts". The referenced objective is inappropriate, there is no expectation that the operator know what occurs at each given load block of the Sequencer. There is no objective that requires the operator to know this. The referenced portion of the lesson plan, does not reference itself to objective 3.8.3. All that is required is that the operator knows what happens to each component, i.e. end result for plant alignment upon the various sequencer initiation signals. L.P. 1XC207, does break each sequencer into the respective load groups by time just to make the flow of the lesson easier for operator understanding. It is easier to talk in blocks of information, building the entire picture and then summarizing at the end.

If the lesson plan is used in it's entirety, and the person using the lesson plan understands the systems at San Onofre, it would have informed the question writer that the wording of the question would not have provided the desired response.

Two pages prior to that referenced by the NRC Examiner, pg 18, the reason for the inaccuracy of the question wording is provided. In the content part of the lesson the response for time 0 seconds states Main Feedwater to S/G's isolates, and Feedwater pump's HVs reposition to SI position. From lessons that the students received earlier in their training program, they understand that when these valves reposition, whether initiated by an SI or manual operation of the valves, the recirc valves to the condenser reposition.

The lesson plan does state on the referenced page, pg 20, in the content section, that at time D.G. breaker closed +2 seconds, that the feedwater pump recirc to condenser closes. The Instructor activity section directly across from this statement clarifies that this is only an initiation signal with the statement "Sequencer output to load group "C". The students would have already discussed the HV's closure before and be instructed that this is only another signal to close the recirc valves, and that they should already be closed.

Procedure SO1-4-46, is not titled "Safety Injection System Operation." The title of SO1-4-46, is "Sequencer Operation." This procedure does not support the NRC examination question. The procedure simply discusses the following: 1) De-energizing Sequencer Amber Lights, 2) Energizing Sequencer Amber Lights, 3) De-energizing the Sequencer, and 4) Energizing the sequencer.

Reference to Dwgs 5149178 through 5149182 are the elementaries associated with the Sequencer Load Blocks. They only support that a signal is provided to feedwater recirc valves at the time specified.

The reference material provided by SCE was adequate to allow proper addressal of this question and answer. However, it would take knowledge of system interrelations not covered in the specific lesson plan referenced.

SCE REFERENCE:

1. L.P. 1XC207, Obj 3.8.3, Pgs 18 and 20
2. SO1-4-46, Safety Injection System Operation"
3. Drawings 5149178 through 5149182
4. 1543 sheet 1
5. 1542 sheet 33

SCE REQUESTED RESOLUTION: Delete question; no correct answer available.