ENCLOSURE 1

EXAMINATION REPORT - 50-302/OL-85-02

Facility Licensee: Florida Power Corporation
P. O. Box 14042, M.A.C.H-2
St. Petersburg, FL 33733

Facility Name: Crystal River Unit 3

Facility Docket No. 50-302

Requalification examinations were administered at Crystal River Nuclear Plant near Crystal River, FL.

Chief Examiner: Sandy Lawyer — Sandy Lawyer — 5/23/85 — Date Signed

Approved by: Bruce A. Wilson — Bruce A. Wilson, Section Chief — 5/23/85 — Date Signed

Summary:

Requalification examinations on May 14-16, 1985

Written requalification examinations were administered to six SROs and eight ROs; oral requalification examinations were administered to three SRO's and four RO's; five of the SROs and seven of the ROs passed these examinations.

This was the first of two scheduled re-examinations following the March 1985 Requalification Program evaluation conducted by the NRC. Oral examinations were waived for those seven individuals who passed this phase of the requalification examinations in March.

The performance on this portion of the requalification examinations (85.7% pass rate) is an indication that corrective actions applied to the Crystal River requalification training program are having the intended result of correcting past deficiencies.

REPORT DETAILS

1. Facility Employees Contacted:

R. C. Zareck, Nuclear Operations Instructor, (R)
L. C. Kelley, Manager Nuclear Operations Training, (E)
E. M. Howard, Director, Site Nuclear Operations, (E)
P. F. McKee, Plant Manager, (E)
G. L. Boldt, Plant Operations Manager, (R/E)
R. T. Wittman, Jr., Operations Superintendent (E)
M. F. Penovich, Training Superintendent (E)
J. L. Bufe, Nuclear Compliance Specialist (E)
E. R. Carlson, Training Consultant (E)
J. G. Smith, Nuclear Shift Supervisor (R)
M. P. Holmes, Nuclear Operations Instructor (R)

NOTE: "R" indicates present at examination review
"E" indicates present at exit meeting

2. Examiners:

B. A. Wilson, NRC
S. Lawyer, NRC*
J. C. Huenefeld, PNL

*Chief Examiner

3. Examination Review Meeting

At the conclusion of the written examination, the examiners met with facility representatives (identified in 1. above) to review the written examinations and answer keys. Specific facility comments and associated NRC resolution of those comments follow:

NOTE: Comments on questions duplicated between exams are only detailed once.

a. RO Exam

(1) Question 1.18

Facility Comment - This question does not seem to be at a Reactor Operator (RO) level of knowledge.

NRC Resolution - This question requires only a very general knowledge of the basis of the shutdown margin requirement. This level of knowledge is consistent with that necessary to understand the functions of the related safety systems. (See 10 CFR 55.21g). No change required.

(2) Question 1.22a

Facility Comment - Use of the words "full flow" in reference to HPI makes the question ambiguous.

NRC Resolution - We concur with this comment. The question was obtained from the Crystal River draft manual on "Reactor Heat Transfer and Thermal Hydraulics." The statements are made:

> "The size of the leak in a LOCA situation determines the need of OTSG cooling. Simply supplying water (HPI) to the core may not be sufficient."

It is later stated in this manual that:

> If the leak is small ... the OTSG must be used to augment the energy removal from the (RCS). During final efforts to cool the core during a small leak without OTSG availability, the operator may have to "create a larger leak" by opening the PORV.

This is supported by AP-450, "Emergency Feedwater Actuation" which requires the operator to establish HPI-PORV core cooling if no feedwater is available (therefore, no OTSG's). Also, step 24 of AP-580, "Engineered Safeguards System Actuation" gives the same instruction. The term "full flow" is not defined explicitly, but is generally interpreted as two HPI pumps running and the four injection valves open. AP-530, "Natural Circulation" lists the condition of HPI-PORV cooling as:

> BWST Suction Valves Open
> 2 HPI pumps running
> 4 injection valves open
> PORV and block valve open

We therefore agree that HPI-PORV cooling can be equated with full HPI flow which renders question 1.22a ambiguous. The question was deleted.

(3) Question 1.23

Facility Comment - We suggest that alternate wording also be accepted for A and C. The proposed wording for A is "RCS pressure axis" and for C "minimum DNBR limit (1.30)".

NRC Resolution - The proposed wording is equivalent and was added to the answer key.

(4) Question 2.4

Facility Comment - Choice (b) is also an incorrect statement. The STM provided to the NRC was in error. A copy of NAO-91 will be provided to support out recommendation that both answer (b) and (d) be accepted.

NRC Resolution - NAO-91 was provided and supports the recommendation. The answer key was changed.

(5) Question 2.11

Facility Comment - Choice (d) is also a correct answer. This is not reflected in STM-405 which was provided to the NRC, but is in ANO-91 on pg. 15.

NRC Resolution - Based upon the additional reference material, we concur. The answer key was changed.

(6) Question 2.13

Facility Comment - The SF cooling pump air handling fans are not required for emergency operation even though they are powered from ES buses. The STM incorrectly states that the fans will continue operating during post accident conditions. It should more properly state that they may be operated. We recommend this question be deleted.

NRC Resolution - Review of training material and discussion with senior operating personnel confirms the facility comment. The question was deleted.

(7) Question 2.19

Facility Comment - On the answer key drawing, the device shown as a switch below the leftmost transformer is a voltage regulator.

NRC Resolution - The answer key drawing was incorrectly labeled by us. The facility comment is accepted. The answer key was changed.

(8) Question 2.23

Facility Comment - The answer key is incorrect. It should read "No circulating water pump operating; condenser vacuum of <5" Hg. This is reflected in the newly revised STM, Chapter 504, Rev. 1 dated 1/15/85, Pg. 110.

NRC Resolution - We concur. The answer key was changed.

(9) Question 3.03

Facility Comment - The quality of this question could be improved by changing choice (c) to read "... will stop further out travel...". We suggest this be rephrased before entry into the question bank.

NRC Resolution - We concur. The wording was consistent with the STM provided; however, the suggested wording should be used in future usage of this question. No change to the current question or answer sheet is appropriate.

(10) Question 3.11

Facility Comment - This task is not performed by plant operators at Crystal River.

NRC Resolution - This is an instrument within the scope of 10 CFR 55.21(f). Power gain adjustments, if not made by a licensed person, must only be made under his cognizance. Also, the STM provided clearly indicates how the power gain adjustment is made. No change required.

(11) Question 3.19

Facility Comment - The question is somewhat ambiguous in that (b) could be seen as a correct statement, i.e., all heater banks will be de-energized if pressurizer level <30".

NRC Resolution - We concur. The question was intended to measure knowledge of the heater cutoff setpoint of 40 inches. The wording of the question however, did not properly elicit this knowledge. The question was deleted.

(12) Question 3.21

Facility Comment - In choice (d), when the pressure comes back up, the air fail reset will auto reset. This is a recent revision to the lesson plan. Since the candidates should not be confused, no change to the current questions or answer key should be made but the question should be reworded prior to future use.

NRC Comment - We concur. No change to current questions or answer key is warranted.

(13) Question 4.03

Facility Comment - During administration of the examination, a candidate notified the examiners that there were two correct answers due to a recent revision to AP-330. This was verified by

the examiners. Facility reviewers were notified of the change to the answer key.

NRC Resolution - Revision 1 to AP-330, dated 3/6/85 had deleted step (d). The answer key was changed.

(14) Question 4.09

Facility Comment - While the question is acceptable, it could be improved by recognizing that there is a two second time delay on the 110 psig auto start. This should be reworded, if possible, before future use.

NRC Resolution - The procedural reference from which the question was obtained did not mention the two second time delay. No change required.

b. SRO Exam

(1) Question 5.14a

Facility Comment - Same as RO Question 1.22a.

NRC Resolution - The question was deleted.

(2) Question 5.15

Facility Comment - Same as RO Question 1.23.

NRC Resolution - The proposed wording was added to the answer key.

(3) Question 6.3

Facility Comment - Same as RO Question 2.11.

NRC Resolution - The answer key was changed to accept choice (a) or (d).

(4) Question 6.9

Facility comment - Same as RO Question 2.19

NRC Resolution - The answer key drawing was relabeled appropriately.

(5) Question 6.19

Facility Comment - Same as RO Question 3.21

NRC Resolution - No change required.

(6) Question 7.3

Facility Comment - Same as RO Question 4.3

NRC Resolution - The answer key was changed to accept either (b) or (d).

(7) Question 7.9

Facility Comment - Same as RO question 4.9

NRC Resolution - No change required.

(8) Question 7.13

Facility Comment - None

NRC Resolution - Post grading review showed all candidates to answer "grapple tube up" light as one of the two required answers. This was not on the answer key which was obtained from FP-203, Rev. 12, page 22 which states:

> After a fuel assembly has been lifted, the Operator shall not move the bridge/trolley until the "Z-Z" tape has been read to verify grapple position and the "Z-Z" tape "full up" reading has been reported to the CCRO.

However, on page 12, the procedure states that:

> After a fuel assembly has been lifted, as indicated by the "grapple tube up" light, check the "Z-Z" tape to verify the grapple position before moving the bridge or trolley.

Therefore, any two of these three answers are accepted.

(9) Question 8.7

Facility Comment - This question should be revised in the future to reflect the conditional requirement on Mode 2 applicability in STS, i.e., Keff $\geq$ 1.

NRC Resolution - This change will be considered prior to future use of this question. No change to current question or answer key required.

(10) Question 8.17

Facility Comment - This question should be revised prior to future use to say "when an STS required deluge and sprinkler system...".

NRC Resolution - The proposed wording will be considered. No change to current question or answer key required.

4. Exit Meeting

At the conclusion of the site visit, the examiners met with representatives of the plant staff to discuss the results of the examinations. Those individuals who clearly passed the oral examination were identified.

No generic weaknesses were noted by the examiners at this time. A comprehensive summary of generic weaknesses will be presented at the conclusion of the requalification reexaminations.

ENCLOSURE 3

U. S. NUCLEAR REGULATORY COMMISSION

SENIOR REACTOR OPERATOR REQUALIFICATION EXAMINATION

Facility: Crystal River Unit 3
Reactor Type: PWR B&W
Date Administered: May 14, 1985
Examiners: S. Lawyer
Candidate: _____

INSTRUCTIONS TC CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheets 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 four (4) hours after the examination starts.

Category Value	% of Total	Candidate's Score	% of Category Value		Category
25	25	_____	_____	5.	Theory of Nuclear Power Plant Operation, Fluids and Thermodynamics
25	25	_____	_____	6.	Plant Systems: Design, Control & Instrumentation
25	25	_____	_____	7.	Procedures-Normal, Abnormal, Emergency and Radiological Control
25	25	_____	_____	8.	Administrative Procedures, Conditions and Limitations
100	100	_____	_____		TOTALS

Final Grade _____%

All work done on this exam is my own, I have neither given or received aid.

_____
Candidate's Signature

5.0 THEORY OF NUCLEAR POWER PLANT OPERATION, FLUIDS AND THERMODYNAMICS (25.0)

5.1 The ratio of both Pu-239 and Pu-240 atoms to U-235 atoms changes over core life. Which one of the pairs of parameters below are most affected by this change? (1.0)

a. Moderator temperature coefficient and doppler coefficient

b. Doppler coefficient and beta

c. Beta and thermal neutron diffusion length

d. Thermal neutron diffusion length and moderator temperature coefficient

5.2 A moderator is necessary to slow neutrons down to thermal energies. Which of the following is the CORRECT reason for operating with thermal instead of fast neutrons? (1.0)

a. Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

b. Reactors operating primarily on fast neutrons are inherently unstable and have a higher risk of going prompt critical.

c. The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.

d. Doppler and moderator temperature coefficients become positive as neutron energy increases.

5.3 Which one of the following factors will help, rather than hinder, natural circulation? (1.0)

a. Lowering OTSG level

b. Lowering RCS pressure

c. Increasing RCS temperature

d. Lowering turbine bypass valve setpoint

5.4 Following a trip from full power with the reactor shutdown and 4 RCPs operating, the 125 psi bias is suddenly removed from the turbine bypass valves. Which one of the following statements best describes plant response? (1.0)

a. OTSG pressure drops and levels rise. The increased OTSG levels cause an overcooling of the RCS.

b. The OTSG saturation temperature drops causing a decrease in RCS T_c and a rapid drop in pressurizer level.

c. Since OTSG pressures drop 125 psi, BTU limit alarms will be received on both generators and feedwater will cut back.

d. The resulting cooldown of the RCS will decrease the shutdown margin to less than Tech Spec limits.

5.5 During a xenon-free reactor startup, critical data was inadvertently taken two decades below the required Intermediate Range (IR) level (10^{-10} amps). The critical data was then taken at the proper IR level (10^{-8} amps). Assuming RCS temperature and boron concentrations did <u>not</u> change, which one of the following statements is <u>CORRECT</u>? (1.0)

a. The critical rod position taken at the proper IR level is LESS THAN the critical rod position taken two decades below the proper IR level.

b. The critical rod position taken at the proper IR level is THE SAME AS the critical rod position taken two decades below the proper IR level.

c. The critical rod position taken at the proper IR level is GREATER THAN the critical rod position taken two decades below the proper IR level.

d. There is not enough information given to determine the relationship between the critical rod position taken at the proper IR level and the critical rod position taken two decades below the proper IR level.

5.6 The reactor trips from full power, equilibrium xenon conditions. Twenty-four hours later the reactor is brought critical at 10^{-8} amps on the intermediate range. If power level is maintained at 10^{-8} amps for several hours, which of the following statements is CORRECT concerning control rod motion? (1.0)

a. Rods will have to be withdrawn due to xenon build-in.

b. Rods will have to be rapidly inserted since the critical reactor will cause a high rate of xenon burnout.

c. Rods will have to be inserted since xenon will closely follow its normal decay rate.

d. Rods will approximately remain as is as the xenon establishes its equilibrium value for this power level.

5.7 Which one of the following is CORRECT concerning starting of positive displacement (PD) and centrifugal pumps? (1.0)

a. Neither type of pump should be started with its discharge valve shut.

b. Both types of pumps should be started with their discharge valves shut.

c. A PD pump should be started with its discharge valve shut and a centrifugal pump started with its discharge valve open.

d. A PD pump should be started with its discharge valve open and a centrifugal pump started with its discharge valve shut.

5.8 Runout of a centrifugal pump is best characterized by which one of the following? (1.0)

a. high motor current, high flow rate and high discharge pressure.

b. low motor current, high flow rate and low discharge pressure.

c. low motor current, low flow rate and high discharge pressure.

d. high motor current, high flow rate and low discharge pressure.

5.9 Which one of the following is the CORRECT order of the heat transfer processes as heat flux increases? (1.0)

a. bulk boiling, sub-cooled nucleate boiling, film boiling, DNB
b. sub-cooled nucleate boiling, bulk boiling, film boiling, DNB
c. bulk boiling, sub-cooled nucleate boiling, DNB, film boiling
d. sub-cooled nucleate boiling, bulk boiling, DNB, film boiling

5.10 In performing an estimated critical boron concentration pursuant to OP-210, the attached worksheet is being utilized. Assuming the information shown on that sheet, which one of the following pairs of items will be positive (+)? (1.0)

a. A&D
b. B&D
c. B&C
d. A&C

5.11 Which one of the following is NOT part of the accident postulated for the basis of the shutdown margin requirement? (1.0)

a. Main steamline break
b. Beginning-of-Life (BOL) condition
c. Tavg at no load operating temperature
d. Most reactive rod struck out

5.12 Which one of the following is NOT one of the DNB related parameters that must be maintained within Tech Spec limits? (1.0)

a. Hot leg temperature
b. Reactor Coolant pressure
c. Reactor Coolant flow rate
d. Axial power imbalance

5.13 Which of the following will NOT change over core life? (1.0)

a. The minimum acceptable shutdown margin

b. The acceptable flux imbalance band

c. The control rod reactivity worth

d. The power defect reactivity worth.

~~5.14 TRUE or FALSE~~

~~a. Following a LOCA, if HPI actuates and develops full flow, sufficient core cooling is ensured without the need for OTSG cooling, regardless of the size of the LOCA.~~ ~~(0.5)~~

b. Since the RCP Trip criteria is based on the SBLOCA analyses, you are not required to trip the RCPs following ES actuation due to a Main Steam Line Break Accident. (0.5)

5.15 Refer to Figure 1, "Reactor Core Safety Limit." Identify by name or title the parts of the Figure marked A, B, C, and D. (2.0)

5.16 Following an accident that results in excessive core damage, what are <u>two</u> significant sources of Hydrogen generation. (1.0)

5.17 When synchronzing the generator to the grid, OP-203, "Plant Startup" directs the operator to regulate turbine speed to slowly rotate the synchroscope in the fast (clockwise) direction. Which choice below <u>CORRECTLY</u> gives the <u>two</u> parameters that the synchroscope is indicating? (1.0)

a. Current and voltage differences

b. Current and frequency differences

c. Voltage and phase differences

d. Frequency and phase differences

5.18 Which one of the following statements is <u>CORRECT</u> concerning the paralleling of electrical systems? (1.0)

a. Although it is desireable to have speed and phase position matched, it is much more important to have voltages matched.

b. If voltages are not matched at the time the synchronizing switch is closed, there will be VAR flow from the lower voltage source to the higher one.

c. If the incoming machine is at synchronous speed but out of phase with the running when the breaker is closed, heavy currents will flow to either accelerate or retard the incoming machine.

d. If the incoming machine is in phase but slightly faster than synchronous speed when paralleled, the system will tend to speed up the incoming machine to synchronous speed.

5.19 Which one of the following is <u>NOT</u> one of the ECCS Acceptance Criteria as specified in 10 CFR 50.46? (1.0)

a. Peak cladding temperature shall not exceed 2200°F

b. DNB and Kw/ft limits shall be maintained $\leq$ 1.30 and $\geq$ 18.0 kw/ft. respectively.

c. Total oxidation of cladding shall nowhere exceed 17% of the total cladding thickness before oxidation.

d. Total amount of hydrogen generated shall not exceed 1% of the maximum hypothetical amount.

5.20 Figure 5.20 is a temperature profile from the fuel centerline to the coolant. Which of the following is CORRECT concerning anticipated temperatures as shown in this Figure? (1.0)

a. A thumb rule approximation is 1000°F from centerline to fuel surface, 500°F across the gap and 100° across the cladding (for nominal heat rate)

b. A thumb rule approximation is 1000°F from centerline to fuel surface, 100°F across the gap and 50°F across the cladding (for nominal heat rate)

c. For the nominal heat rate, the ΔT across the fuel, across the clad, and across the gap are approximately the same

d. ΔT from fuel centerline to fuel surface must be kept less than 1000°F to maintain peak clad temperature less than 2200°F.

5.21 A negative MTC is great to have for safe reactor control, but creates a problem when it comes to cold water accidents or a steam/feedline break. What inherent feature of the CR3 low enriched core acts intially to limit the severity of these transients? (1)

a. Moderator Temperature Coefficient
b. Doppler Coefficient
c. Voids Coefficient
d. Redistribution

5.22 Which of the following is CORRECT concerning temperatures at which fuel and/or cladding damage will occur? (1.0)

a. The cladding will melt at approximately 2200°F.

b. Uranium dioxide fuel will melt at approximately the same melting temperature as the cladding.

c. UO_2 melt limit is approximately 5000°F while Zirconium will melt at about 3300°F.

d. The melting temperature for both fuel and cladding drop sharply over core life.

5.23 Answer the following statements concerning core power distribution and thermal design limits TRUE or FALSE.

a. Axial Power Imbalance limitations only apply in Mode 1 above 40% of Rated Thermal Power. (0.5)

b. Hot Channel Factors (F_Q and $F^N\Delta H$) are only monitored once for each new core prior to exceeding 75% Full Power. (0.5)

c. The Quadrant Power Tilt Limits are <u>less</u> restrictive when measured by Power Range Channels than by the Symmetrical Incore Detector System. (0.5)

d. Power distribution limits are based on maintaining minimum DNBR, peak linear power density and LOCA analyses criteria. (0.5)

END OF SECTION 5

6.0 PLANT SYSTEM DESIGN, CONTROL AND INSTRUMENTATION (25.0)

6.1 Which of the following statements concerning the Reactor Building Isolation and Cooling System is CORRECT? (1.0)

a. Diverse Containment Isolation occurs when HPI is automatically or manually initiated.

b. Diverse Containment Isolation will isolate NSCCCW to the Reactor Coolant Pumps.

c. Diverse Containment Isolation will close the CI flow to the RB fans and open the SW valves.

d. When HPI automatically initiates, Diverse Containment Isolation occurs and the RB fans are started or shifted to slow speed.

6.2 Many important pumps have annunciators which indicate when the pump is out-of-service, for example: ES Annunciator D-3-3 is labeled "DH Pump 'B' OUT OF SERV". Which one of the following is an indicated condition for this type of annunciator? (1.0)

a. No breaker DC control power.

b. Breaker control switch in normal after start, breaker open, breaker racked in.

c. Overload relay actuated.

d. Excessive motor amps.

6.3 With regard to the Reactor Building Spray System, which of the following statements is CORRECT? (1.0)

a. Upon receipt of an ES actutation signal of 4 psig in the RB, the NaOH tank outlet valves (BSV-11 and 12) will automatically stroke to the full open position.

b. A high RB pressure signal (30 psig increasing) starts the 2 RB spray pumps and automatically strokes open the suction valves (BSV-16 and 17).

c. The spray pumps start on the 4 psig signal while the spray header supply valves (BSV-3 and 4) stroke open on the 30 psig RB signal.

d. The 4 psig signal opens all three sets of valves (BSV-3 and 4, BSV-11 and 12, and BSV-16 and 17).

6.4 Select the CORRECT statement concerning the Nuclear Services Booster Pumps and CRD Cooling System. (1.0)

a. One pump is normally operated with the other serving as backup. A drop in line pressure (25 psi) will start the idle pump.

b. On an ES signal, the supply and return valves to the CRDM coolers will close and the booster pumps will have to be manually secured.

c. SWP-2A is powered from ES MCC 3A2 and SWP-2B is powered from ES MCC 3B2.

d. Low level in the SW surge tanks will trip the NS booster pumps.

6.5 Select the CORRECT statement concerning the Makeup Pump Lube Oil System. (1.0)

a. If the main gear oil pump control switch is in Auto, the pump will start and run for three minutes after the makeup pump starts.

b. The backup gear oil pump will start (if in Auto) when oil pressure reaches 7 psig and will automatically stop when oil pressure reaches 20 psig.

c. If the main lube oil pump control switch is in Auto, the pump will start and run for three minutes after the makeup pump starts.

d. The backup lube oil pump has no auto start provisions and can be used as a back up for the gear oil system.

6.6 Select the CORRECT statement about the Makeup and Purification System. (1.0)

a. The block orifice has two bypasses, (MUV-51 and MUV-48) both of which are remotely operated from the control room.

b. The letdown line connections to the Decay Heat Removal System are prior to the prefilters and after the makeup filters.

c. A temperature element (TE-5) on the letdown line alarms at 130 °F and closes the letdown cooler outlet valves (MUV-40 and MUV-41) at 135 °F to protect the letdown coolers.

d. The deborating demineralizer may be operated in parallel or series with the makeup demineralizers.

6.7 Which one of the following statements is CORRECT regarding the design of the internals vent valves? (1.0)

a. The vent valves are designed to open in the event of a hot leg break when the pressure differential reaches at least 43 psi.

b. The vent valves are designed to open in the event of a cold leg break when the pressure differential reaches at least 43 psi.

c. In the event of a hot leg break, the vent valves should begin to open with a ΔP of about 0.3 psid and be fully open at 1.5 psid.

d. In the event of a cold leg break, the vent valves should begin to open with a ΔP of about 0.3 psid and be fully open at 1.5 psid.

6.8 Which one of the following is NOT monitored for in the RANGE subsystem of the Post Accident Sampling System? (1.0)

a. High range noble gas

b. Hydrogen

c. Particulate

d. Iodine

6.9 On Figure 7.19, show the connections and components between 480V MCC Safeguards Bus and a typical 120V A.C. Vital Bus. Include the following: Battery chargers, inverters, automatic and manual switches and transformers. It is not necessary to show breakers or to label components (the labels shown - 3A and 3A-1 are for illustration only). (2.0)

6.10 Select the CORRECT statement concerning the site fire protection systems. (1.0)

a. All areas protected by a fixed water spray system use heat detectors to actuate the alarms.

b. To prevent accidental actuation, it requires two detectors actuating to cause operation of the fixed water spray system on the charcoal filter banks.

c. A wet pipe sprinkler system is used to protect the Emergency Diesel Generators.

d. Lube oil systems on the reactor coolant pumps, feedwater pumps and main turbine are protected by a fixed water spray system.

6.11 TRUE or FALSE

a. Maximum flow for one HPI pump is approximately 540 gpm @ 600 psig. (.5)

b. LPI pump high flow alarm occurs at about 3400 GPM and runout flow is about 4100 GPM. (.5)

6.12 Which of the following Decay Heat System Interlocks is CORRECT? (1.0)

a. Separate RC pressure transmitters will shut DHV-3 and DHV-4 at approximately 284 psig.

b. Separate RC pressure transmitters will shut DHV-3, DHV-4 and DHV-41 at approximately 284 psig.

c. A single RC pressure transmitter will shut DHV-3 and DHV-4 at approximately 284 psig.

d. A single RC pressure transmitter will shut DHV-3, DHV-4, and DHV-41 at approximately 284 psig.

6.13 Which of the following statements is INCORRECT regarding bypassing the Steam Line Rupture Matrix? (1.0)

a. During a normal cooldown, when OTSG pressure drops below 725 psig, the matrix can be bypassed by depressing two bypass pushbuttons on the main control board.

b. During a normal cooldown, the four maintenance bypass key switches must be utilized before the operator can depress the two bypass pushbuttons.

c. Following an actuation, if either the < 725 or < 600 pressure switch has actuated, a bypass permit will be present.

d. Following an actuation, in addition to a bypass permit, the operator must depress the two main control board push buttons in order to bypass the matrix.

6.14 Which of the following statements is CORRECT concerning the Intermediate Range Compensated Ionization Chambers? (1.0)

a. The detectors are surrounded by four inches of lead for shielding fast neutron radiation.

b. The boron lined chamber is sensitive to neutron and gamma radiation while the unlined chamber is sensitive only to gamma rays.

c. The compensated ion chamber is designed to remove the gamma signal only at high reactor power levels.

d. Undercompensation will cause loss of some neutron current as well as blocking gamma current.

6.15 Which of the following statements is CORRECT concerning the operation of a typical Atmospheric Radiation Monitor (for example, RM-A1 or A2)? (1.0)

a. The sampled air will pass through a fixed particulate filter. The particulate buildup on the filter is then measured by a GM detector which outputs the measurement in CPM.

b. After passage through the particulate filter the air is drawn into a gas sampler which detects gaseous activity with a scintillation detector.

c. A gamma scintillation detector is used to measure the iodine activity on a fixed iodine filter (activated charcoal).

d. The flow path of the sampled air through RM-A2 is the particulate filter, the gas sampler, followed by the iodine filter.

6.16 Select the CORRECT statement with regard to speed control (Governor) of the Emergency Diesel Generators. (1.0)

a. As a general rule, D-G units running alone should have the SPEED DROOP control set on 0 (zero).

b. The synchronizer motor, mounted on top of the governor, allows the operator to match the voltage of the D-G with running voltage before synchronizing to the system.

c. The LOAD LIMIT control may be used for shutting down the diesel by turning the LOAD LIMIT control to zero.

d. The SYNC INDICATOR, located directly below the SYNCHRONIZER control indicates if the D-G is in phase with the system.

6.17 When the RPS is in Shutdown Bypass, which one of the following is CORRECT? (1.0)

a. A high pressure trip of 1720 psig is administratively imposed and an overpower trip of 5% automatically imposed.

b. The high pressure trip at 2355 psig is bypassed.

c. The four trips bypassed are high temperature, low pressure, variable low pressure and flux/delta flux/flow.

d. The RCP Power Monitor trip is bypassed.

6.18 Cross-Tie Blocking Interlocks are provided to prevent paralleling of both D-G. Refer to Figure 3.18 and select the CORRECT statement. (1.0)

a. If breakers 3209, 3210 and 3205 are all closed, the amber lamp (Block Closing Actuated 3206) will be lit, thus permitting breaker 3206 to be closed.

b. If breakers 3209 and (i) 3205 and 3206, or (ii) 3207 and 3208, or (iii) 3211 and 3212 are closed, the amber lamp (DG Parallel Block Act) will be lit and breaker 3210 can not be closed.

c. If the amber lamp (Block Closing Actuated 3208) is lit, it means breaker 3208 cannot be closed because the 3B bus is already being fed from the 3A bus (through 3207) and no Diesels are running.

d. If both Diesels are feeding their respective buses (3209 closed and 3210 closed) all Block Closing Actuated Lamps will be lit.

6.19 Which one of the following is CORRECT concerning the "Air Fail Reset" pushbuttons for MUV-16, 31 and 51? (1.0)

a. The pushbutton only indicates loss of air to the associated valve E/P controller.

b. The pushbutton indicates loss of air to E/P controllers for MUV-16 and 51 and also loss of air to the valve positioner for MUV-31.

c. On loss of air supply, the solenoid valve supplying air to the air lock valve will de-energize, causing the affected valve (16, 31 or 51) to close.

d. When air pressure has increased, depressing the air fail reset pushbutton will unlock MUV-16, 31 or 51.

6.20 a. What two control room indications of abnormal RCP operation, require the pump to be shutdown immediately? (1.0)

b. What control room indication of abnormal RCP operation, requires power level to be reduced to 72%, at 30%/min, then tripping the affected RCP? (1.0)

6.21 Which one of the following is NOT a Tech Spec required monitoring channel for the Waste Gas System? (1.0)

a. Hydrogen

b. Noble gas

c. Tritium

d. Oxygen

6.22 Answer the following TRUE or FALSE concerning the Meteorological Measurement System.

a. A strongly positive ΔT indicates a temperature inversion. (0.5)

b. A strong thermal inversion may cause wind direction values between the upper and lower levels to be significantly different. (0.5)

c. The wind direction is the way towards which the wind is blowing (e.g., 180° means the wind is blowing toward the South) (0.5)

d. Tech Specs require Waste gas releases to be terminated if the meteorological monitoring instrumentation channels are inoperable. (0.5)

END OF SECTION 6

7.0 PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL (25.0)

7.01 **Match the Condition with the appropriate Radiation Monitor Alarm.** (2.5)

Radiation Monitor	Condition
a. RM-A1	1. Control complex ventilation return air has exceeded setpoint on gas or iodine/particulate channels.
b. RM-A2	2. Possible spent fuel radioactivity leak.
c. RM-A3	3. Reactor Building purge duct exhaust to the atmosphere has exceeded setpoint on gas channel.
d. RM-A4	4. Auxiliary Building ventilation exhaust to the atmosphere has exceeded setpoint on gas channel.
e. RM-A5	5. Possible waste gas tank or piping leak.

7.02 List your Immediate Actions in response to an alarm from RM-L2. (0.5)

7.03 Which of the following is NOT an Immediate Action required in AP-330, "Loss of Nuclear Services Water". (1.0)

a. Trip all NSCCCW pumps: SWP-A, SWP-B, SWP-C, SWP-2A, SWP-2B.

b. Establish OTSG levels with emergency feedwater pumps.

c. Trip reactor AND refer to AP-580

d. Close: MUV-50 and MUV-51

7.04 Immediate Action step 3 of AP-380, "Engineered Safeguards System Actuation," states the following:

Ensure HPI trains start
- 2 HPI pumps
- SWPs
- RWPs

Step 6 of the same procedure states:

Ensure LPI trains start
- DHPs
- DCPs
- RWPs

Which statement is CORRECT concerning the "RWPs" referred to in AP-380? (1.0)

a. The RWPs in step 3 and step 6 are the same. The verification is repeated to ensure it is accomplished.

b. The RWPs in Step 3 refer to RWP-3A and 3B; the RWPs in Step 6 refer to RWP-2A and 2B.

c. Step 3 refers to RWP-1, 2A and 2B while step 6 refers only to RWP-2A and 2B.

d. In Step 3, the RWPs are the Nuclear Services (Emergency) Seawater Pumps while in Step 6, RWPs refer to the Decay Heat (Emergency) Seawater Pumps.

7.05 An Immediate Action of AP-380, "Engineered Safeguards System Actuation," is to:

"Place RB sump pump in PULL-TO-LOCK":

- WDP-2A
- WDP-2B

What is the Remedial Action associated with this step? (1.0)

7.06 The statements below are contained in AP-380, "Engineered Safeguards System Actuation." Fill in the blanks with the appropriate numbers where indicated. (3.0)

When the following conditions exist:

° High Pressure

- Adequate subcooling margin; (a) °F when > 1500 psig
  (b) °F when ≤ 1500 psig
- PZR level ≥ (c)"
- OTSG heat removal

OR

° Low pressure

- LPI flow ≥ (d) GPM in each train and stable for ≥ (e) minutes, Then STOP HPI.
- If TC < (f) °F, then refer to EP-220, "Pressurized Thermal Shock."

° Required Cooldown Rates

Normal	≤ (g) °F/hr
Natural Circulation	(h) °F/hr

MUV-53 and MUV-257 (recirc valves) must be open when total HPI flow ≤ (i) GPM

Establish required OTSG level

° Any RCP operating	(j) "
° No RCP's, adequate subcooling margin	(k) %
° Less than adequate subcooling margin	(l) %
° < 2 HPI pumps available	(m) %

° If subcooling margin < (n), then go to EP-290, "Inadequate Core Cooling."

° When RC Press ≥ (o) psig, then open PORV.

7.07 Select the INCORRECT statement for the following Limit and Precaution as contained in OP-404, Decay Heat Removal System. (1.0)

"In order to assure that redundant or diverse DHR methods are available during all modes of operation, the following requirements must be met prior to removing a DH train from service."

a. The LPI pump suction valves from BWST (DHV-34 and DHV-35) will be closed and the breakers racked out during periods when the BWST is empty and a BAST is being utilized for emergency boration control.

b. No more than one DH train shall be removed from service at any one time.

c. The requirements for voluntarily entering a degraded mode of operation listed in CP-115 have been met.

d. The refueling transfer canal is flooded, or at least one OTSG is available for cooling either by forced flow or natural circulation, or there is a readily accessible source of borated water during periods of low DH load and the plant is in Mode 5 or 6.

7.08 Which of the following statements is CORRECT concerning DH pump operation in the recirculation mode? (1.0)

a. As long as the minimum flow rate of 80 gpm is not violated, DH pump operation in the recirculation mode is unrestricted.

b. In no event shall the DH pump operate in the recirculation mode continuously for 24 hours or greater than 72 hours per month.

c. DH pump operation in the recirculation mode shall be timed and an entry made in the Control Center notebook.

d. The maximum flow from the DH system to the MUP is restricted to 140 gpm when the DH pumps are in the recirculation mode.

7.09 Select the CORRECT statement concerning the Nuclear Services Cooling System (as per OP-408). (1.0)

a. When SW system pressure drops to 110 psig, SWP-1B automatically starts.

b. When RW system pressure drops to 110 psig, RWP-2B automatically starts.

c. When either emergency SW pump starts, the normal pump will trip in 30 seconds.

d. When either emergency RW pump starts, the normal pump will trip in 30 seconds.

7.10 Where would you expect to find the correct procedure to transfer cooling water for the 3A and 3C makeup pumps from the DC System to the SW System? (1.0)

a. OP-402, Makeup and Purification System

b. OP-705, Emergency Power-DC System

c. OP-408, Nuclear Services Cooling System

d. All three of the above procedures contain these instructions.

7.11 Select the CORRECT statement concerning transfer of Non-Nuclear Instrumentation signals to the ICS (as per OP-501). (1.0)

a. Disconnecting the RC flow signal source from the RPS cabinets has no affect on the ICS.

b. If operating signal source malfunctions make signal source transfer necessary, transfer to another source should be done immediately regardless of ICS operating mode.

c. When changing narrow range RC pressure signals, the PORV (RCV-11) should be open, with the heaters and spray valves in manual.

d. Buffer cards or buffer card modules may be replaced while leaving the affected controllers in auto.

7.12 During fuel handling operations, the polar crane will be "Blue-Tagged" to: (1.0)

a. the Shift Supervisor on duty

b. the person operating the crane

c. the Refueling Consultant

d. the Refueling Supervisor on duty

7.13 The Fuel Handling Bridge Operator in the RB has picked up a fuel assembly and is ready to move it to a position above the designated reactor core location. LIST TWO steps that must be verified or accomplished before he is allowed to move the Bridge/Trolley. (NOTE: Two steps to ensure that the element has been completely raised). (1.0)

7.14 What is the proper orientation of fuel assemblies during refueling operations? (1.0)

a. Identification plates on fuel assemblies should be oriented in the West direction. Serial numbers on control rod assemblies should be in the opposite direction.

b. Identification plates on fuel assemblies should be oriented in the West direction. Serial numbers on control rod assemblies should be in the same direction as the fuel assembly Identification number.

c. Identification plates on fuel assemblies should be oriented in the North direction. Serial numbers on control rod assemblies should be in the opposite direction.

d. Identification plates on fuel assemblies should be oriented in the North direction. Serial numbers on control rod assemblies should be in the same direction as the fuel assembly Identification number.

7.15 Which of the following statements is CORRECT concerning operation of the turbine bypass valves? (1.0)

a. If automatic operation of turbine bypass valves is desired when CRD breakers are open, set turbine header pressure controller to 27% to compensate for +125 psig reactor trip bias.

b. If automatic operation of turbine bypass valves is desired when CRD breakers are open, the ±50 psig throttle pressure error logic must be bypassed.

c. If automatic operation of turbine bypass valves is desired when CRD breakers are open, the ULD must be less than 15% to reset the +50 psig bias.

d. Automatic operation of turbine bypass valves is not possible without first resetting the CRD trip breakers.

7.16 In order to startup a main feedwater pump, (Section 11.3 of OP-605) you must depress and hold the "Speed Signal Bypass" push button. After which of the following steps can you release the "Speed Signal Bypass" without causing the FW Pump Turbine to Trip? (1.0)

a. Verify all white "Permit" lights and speed control at "minimum" with green light on governor speed control switch.

b. Place "Trip/Reset" switch in "Reset" position.

c. Verify the following occurs:

LP Stop Open
HP Stop Open

d. Verify turbine speed greater than 100 RPM.

7.17 During all evolutions involving the makeup pumps, verify operable flow paths for each pump to be operated. Loss of flow through a makeup pump will destroy the pump within approximately: (1.0)

a. 3 seconds

b. 15 seconds

c. 1 minute

d. 3 minutes

7.18 Which of the following choices will correctly complete the statement below? (1.0)

"The maximum weekly exposure is __(1)__. A/The __(2)__ may authorize exposures to __(3)__ by use of Form 912801, Authorization to Exceed Radiation Exposure Limits."

a. (1) 600 mrem
   (2) Nuclear Plant Manager
   (3) 1250 mrem

b. (1) 300 mrem
   (2) Nuclear Plant Manager
   (3) 1250 mrem

c. (1) 300 mrem
   (2) ChemRad Supervisor
   (3) 600 mrem

d. (1) 600 mrem
   (2) ChemRad Supervisor
   (3) 2 Rem

7.19 Which of the following statements is CORRECT concerning RWP's and SRWP's? (1.0)

a. SRWP's are generally required for non-routine work.

b. For emergency, short-term or special situations, the continuous presence of a qualified ChemRad representative may meet the RWP requirement.

c. SRWPs may be issued when periodic radiation surveys show that individuals will not encounter a dose rate in excess of 100 mrem/hr.

d. The RWP will list all equipment allowed to be taken into and removed from a designated area.

7.20 Select the CORRECT statement concerning entrance into a Contaminated Area. (1.0)

a. Only rubber gloves are allowed in contaminated areas.

b. Rubber or plastic gloves used in wet contaminated areas should be taped to the inside of a plastic suit, if one is being worn.

c. Personnel dosimetry and identification badges should be worn inside protective clothing such that they will not fall off and/or become contaminated.

d. In cases of routine or special maintenance that involves high contamination levels, a plastic suit will be required.

7.21 List your Immediate Actions for AP-990, "Shutdown From Outside Control Room" (1.5)

7.22 TRUE or FALSE (0.5)

The first Immediate Action of AP-580, RPS Actuation, is to ensure group 1-7 rods are inserted. The Remedial Action for this step directs you to EP-140, Emergency Reactivity Control.

END OF SECTION 7

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS (25.0)

8.1 According to Administrative Procedure AI-100, an individual should not be permitted to work more than _____ hours in any 48-hour period (excluding shift turnover time) unless authorized at the Nuclear Plant Manager level or above. (Choose the correct number below). (1.0)

a. 12

b. 16

c. 24

d. 32

8.2 According to the Crystal River Emergency Plan Implementing Procedure EM-202, during a Site Area Emergency personnel accountability SHALL be verified within _____ minutes of Site Evacuation. (1.0)

a. 15 minutes

b. 30 minutes

c. 45 minutes

d. 60 minutes

8.3 While in Mode 2, which one of the RCS Chemistry analysis values given below is between the steady state chemistry limit and the transient limit? (1.0)

a. Fluoride 1.4 ppm

b. Boron 2000 ppm

c. Dissolved oxygen 1.4 ppm

d. Chloride .14 ppm

8.4 According to AI-500, "Conduct of Operations", which one of the following positions has the authority to both 1) shutdown the reactor or cause it to be shutdown and 2) start it up and return it to power operation? (1.0)

a. Chief Nuclear Operator

b. Assistant Nuclear Shift Supervisor

c. Nuclear Shift Supervisor

d. Nuclear Operations Superintendent

8.5 Which of the following is responsible for maintaining the refueling log? (1.0)

a. Control Center Refueling Operator

b. Refueling Consultant

c. Refueling Supervisor

d. Shift Supervisor

8.6 Which one of the following choices CORRECTLY states the source range NI monitor requirements during core alterations as specified in FP-203? (1.0)

At least two source range NI monitors shall be operable:

a. each with audible indication in the Control Center and one with visual indication in the Control Center and one with audible indication in containment.

b. each with visual indication in the Control Center and one with audible indication in both the Control Center and containment.

c. one with visual indication in the Control Center and one with audible indication in containment.

d. each with audible and visual indication both in containment and in the Control Center.

8.7 Which one of the following conditions requires action according to Tech Specs in less than 1 hour if in MODE 2? (1.0)

a. The shutdown margin is 1.4%.

b. One train of heat tracing on the BAST is inoperable.

c. The Reactor Coolant System lowest loop temperature (Tavg) is 520°F.

d. Two of the three makeup pumps are inoperable.

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS (25.0)

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c. Nuclear Shift Supervisor

d. Nuclear Operations Superintendent

8.8 Which one of the following situations, while in MODE 1, requires some action to be taken in 1 hour or less? (No surveillance testing in process). (1.0)

a. One safety rod not fully withdrawn.

b. The overlap between regulating rod groups 6 and 7 is determined to be 28%.

c. Two pulse stepping position indicator channels inoperable with all reed switch position indicator channels operable.

d. One APSR is misaligned from its group average height by 5%.

8.9 Which one of the following statements is CORRECT regarding the axial power imbalance? (1.0)

a. Axial power imbalance is not a directly observable quantity and therefore, limits have been established on the nuclear heat flux hot channel factor produced by the imbalance.

b. Axial power imbalance, in addition to maintaining control rod overlap, sequence, and insertion limits, will ensure that hot channel factors are maintained within acceptable limits.

c. The axial power imbalance is defined as the maximum local fuel rod linear power density divided by the average fuel rod linear power density.

d. Negative axial power imbalances are more restrictive due to the coolant temperature rise across the core.

8.10 Which one of the following statements is CORRECT according to the OSIM for; "Documenting Reactor Trip, Recovery, and Plant Shutdown"? (1.0)

a. A reactor trip is any reactor protection system (RPS) action, manual or automatic, which causes the opening of generator breakers 1661 and 1662.

b. When a reactor trip or plant shutdown occurs, the nuclear shift supervisor notifies the SOTA, Nuclear Operations Superintendent, person on call, the NRC (red phone), and the NRC Resident Inspector.

c. The SOTA is the team leader in assessing and justifying restart.

d. A log of reactor trip and shutdown report dates and types will be maintained in the Nuclear Operations Superintendent's office.

8.11 Which statement is CORRECT concerning the "Operator of the Controls"? (1.0)

a. He shall not, under any circumstances, leave the red-carpeted general area.

b. For emergency reasons, he may leave the red-carpeted area only after obtaining a qualified relief Operator at the Controls.

c. In the event of an emergency affecting the safety of operations, he may be momentarily absent from the general area in front of the board. This includes responding to back panel (e.g., ventilation system) indications.

d. At all times (unless properly relieved) he must remain within the confines of the Control Center with an unobstructed view of the operational control panels.

8.12 TRUE OR FALSE

a. Open annunciator links are to be logged in the Equipment Out-of-Service Log. (0.5)

b. Out-of-Service classification can be removed with surveillance outstanding provided functional tests have been completed. (0.5)

c. Short term instructions shall expire in 90 days unless properly amended. (0.5)

d. For non-safety related procedures, a short term instruction may be issued instead of a temporary procedure change. (0.5)

8.13 Which one of the following is properly classified as "Controlled Leakage"? (1.0)

a. Valve packing leaks that are captured and conducted to a sump.

b. Seal water flow from reactor coolant pump seals.

c. Identified and monitored steam generator tube leakage.

d. Leakage into containment atmosphere from known sources.

8.14 During plant startup with the reactor about 2% power, you find that the PORV Block Valve is stuck open and incapable of closing. Which of the following is a CORRECT ACTION (see the attached LCO)? (1.0)

a. Continued operation is allowed provided the PORV is operable and power is removed from the block valve.

b. If Action b. is satisfied you are allowed to increase power into Mode 1. (Block valve cannot be restored to OPERABLE).

c. The PORV must be closed, power removed from the solenoid valve and the block valve must be repaired prior to going to Mode 1.

d. Since the block valve is incapable of closing, you must proceed to Hot Standby within the next 6 hours and Cold Shutdown within the following 30 hours.

8.15 The specific activity of the secondary coolant system shall be < _____ Dose Equivalent I-131. The accident this is based on is a _____. Which choice CORRECTLY provides the missing information? (1.0)

a. 1.0 µCi/gm, Steam Generator Tube Rupture

b. 0.1 µCi/gm, Steam Generator Tube Rupture

c. 1.0 µCi/gm, Steam Line Rupture

d. 0.1 µCi/gm, Steam Line Rupture

8.16 The _____, or his designated alternate, assumes the position of Emergency Coordinator when relieving the NSS. (1.0)

a. Site Director

b. Operations Superintendent

c. Director of Emergency Planning

d. Nuclear Plant Manager

8.17 When a deluge and sprinkler fire system is inoperable, which statement below is the CORRECT required action? (1.0)

a. Commence a unit shutdown within one hour.

b. Establish an hourly fire watch patrol for the affected area.

c. Establish a continuous fire watch with backup fire suppression equipment in the affected area within one hour.

d. Log ambient temperature readings for the affected area hourly.

8.18 A quarterly surveillance requirement of Tech Specs may be extended up to _____ days without declaring the component inoperable due to the surveillance testing not being performed. (1.0)

a. 9

b. 23

c. 32

d. 41

8.19 The attached drawing shows the primary and secondary evacuation areas. Which of the numbered points is the "Crystal River Generation Complex secondary evacuation area (SEA)"? (1.0)

a. 1
b. 2
c. 3
d. 4

8.20 When is the Incore Monitoring System required to be operable? (1.0)

a. Only in Mode 1

b. Only in Mode 1 above 40% power

c. In modes 1 and 2

d. When surveillance is required for Axial Power Imbalance and Quadrant Power Tilt.

8.21 List the two methods that will be used to track and document valve lineups if they are different from that required by a procedure. (1.0)

8.22 CP-115, "In-Plant Equipment Clearance and Switching Orders" states four conditions that require PRC approval of a clearance prior to issuance. List these four conditions. (2.0)

8.23 Is a pump operable if its control switch is in "Pull-to-Lock"? Explain. (1.0)

END OF CATEGORY 8

END OF EXAM

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_0 + at$

$W = v \Delta P$

$\Delta E = 931\ \Delta m$

$\dot{Q} = \dot{m} \Delta h$

$\dot{Q} = \dot{m} C_p \Delta t$

$\dot{Q} = UA \Delta T$

$Pwr = W_f \Delta h$

$P = P_0 10^{SUR(t)}$

$P = P_0 e^{t/T}$

$SUR = 26.06/T$

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$T = (\ell^*/\rho) + [(\beta - \rho)/\bar{\lambda}\rho]$

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\bar{\lambda}\rho)$

$\rho = (K_{eff}^{-1})/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [(\ell^*/(T K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$P = (\bar{\epsilon}\nu V)/(3 \times 10^{10})$

$I = \sigma N$

$A = \lambda N \qquad A = A_0 e^{-\lambda t}$

$\lambda = \ln 2/t_{1/2} = 0.693/t_{1/2}$

$t_{1/2}^{eff} = \dfrac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$I = I_0 e^{-\Sigma x}$

$I = I_0 e^{-\mu x}$

$I = I_0\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

$CR_x = S/(1 - K_{eff_x})$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$M = (1 - K_{eff0})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-4}$ seconds

$\bar{\lambda} = 0.1$ seconds^{-1}

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$

$R/hr = (0.5\ CE)/d^2 (meters)$

$R/hr = 6\ CE/d^2$ (feet)

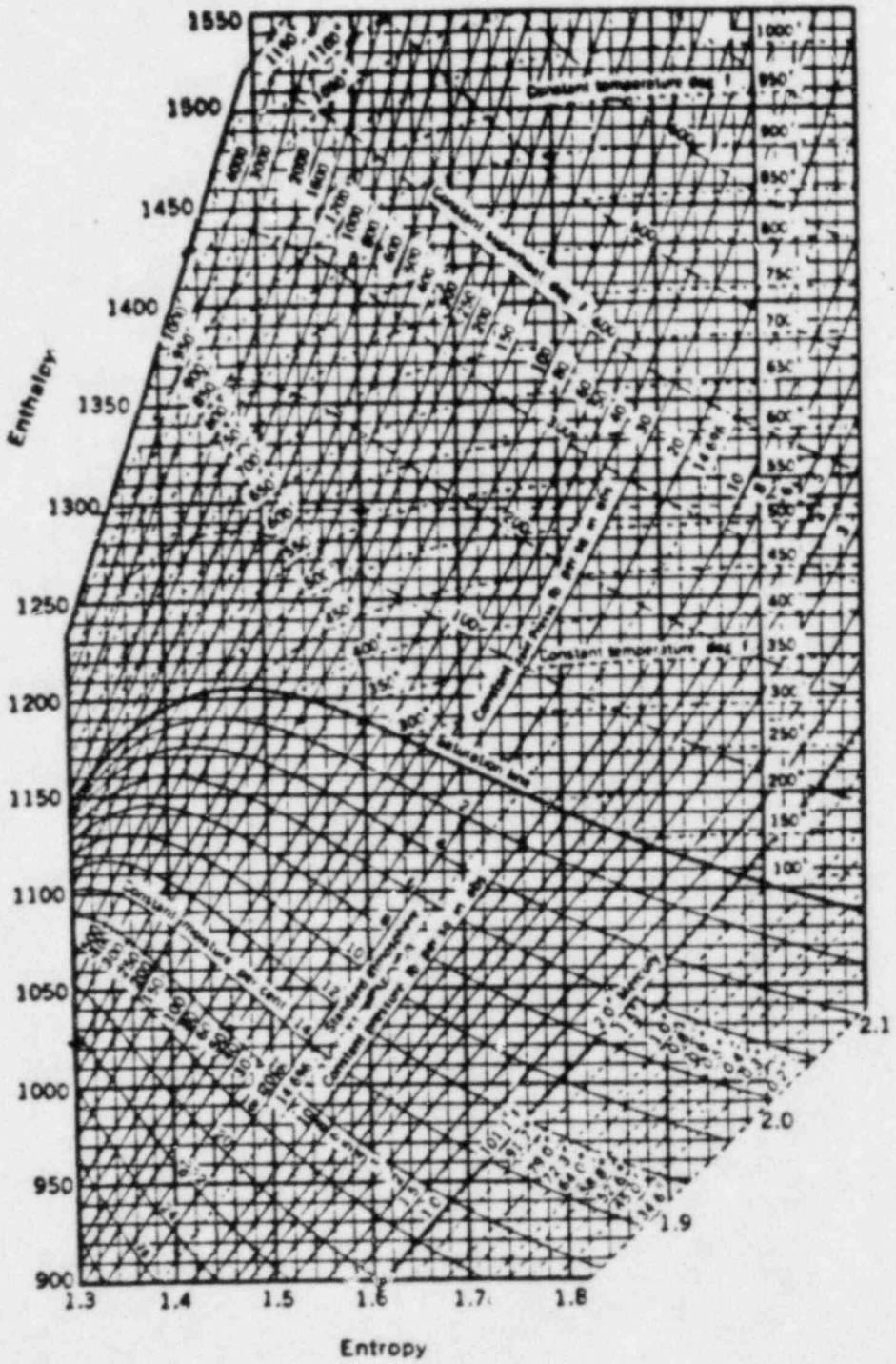
Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3
Heat of vaporization = 970 Btu/lbm
Heat of fusion = 144 Btu/lbm
1 Atm = 14.7 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 lbf/in.

Miscellaneous Conversions

1 curie = 3.7×10^{10} aps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

e = 2.718



Mollier diagram for steam

TABLE D-1.*
Properties of Dry Saturated Steam *
Pressure

Abs press psia	Temp °F	Specific volume		Enthalpy			Entropy		
		Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor	Sat liquid	Evap	Sat vapor
p	t	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
1.0	101.74	0.01614	333.6	69.70	1036.3	1106.0	0.1326	1.8456	1.9782
2.0	126.08	0.01623	173.73	93.99	1022.2	1116.2	0.1749	1.7451	1.9200
3.0	141.48	0.01630	118.71	109.37	1013.2	1122.6	0.2008	1.6855	1.8863
4.0	152.97	0.01636	90.63	120.86	1006.4	1127.3	0.2198	1.6427	1.8625
5.0	162.24	0.01640	73.52	130.13	1001.0	1131.1	0.2347	2.6094	1.8441
6.0	170.06	0.01645	61.98	137.96	996.2	1134.2	0.2472	1.5820	1.8292
7.0	176.85	0.01649	53.64	144.76	992.1	1136.9	0.2581	1.5586	1.8167
8.0	182.86	0.01653	47.34	150.79	988.5	1139.3	0.2674	1.5383	1.8057
9.0	188.28	0.01656	42.40	156.22	985.2	1141.4	0.2759	1.5203	1.7962
10	193.21	0.01659	38.42	161.17	982.1	1143.3	0.2835	1.5041	1.7876
14.696	212.00	0.01672	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566
15	213.03	0.01672	26.29	181.11	969.7	1150.8	0.3135	1.4415	1.7549
20	227.96	0.01683	20.089	196.16	960.1	1156.3	0.3356	1.3962	1.7319
25	240.07	0.01692	16.303	208.42	952.1	1160.6	0.3533	1.3606	1.7139
30	250.33	0.01701	13.746	218.82	945.3	1164.1	0.3680	1.3313	1.6993
35	259.28	0.01708	11.898	227.91	939.2	1167.1	0.3807	1.3063	1.6870
40	267.25	0.01715	10.498	236.03	933.7	1169.7	0.3919	1.2844	1.6763
45	274.44	0.01721	9.401	243.36	928.6	1172.0	0.4019	1.2650	1.6669
50	281.01	0.01727	8.515	250.09	924.0	1174.1	0.4110	1.2474	1.6585
55	287.07	0.01732	7.787	256.30	919.6	1175.9	0.4193	1.2316	1.6509
60	292.71	0.01738	7.175	262.09	915.5	1177.6	0.4270	1.2168	1.6438
65	297.97	0.01743	6.655	267.50	911.6	1179.1	0.4342	1.2032	1.6374
70	302.92	0.01748	6.206	272.61	907.9	1180.6	0.4409	1.1906	1.6315
75	307.60	0.01753	5.816	277.43	904.5	1181.9	0.4472	1.1787	1.6259
80	312.03	0.01757	5.472	282.02	901.1	1183.1	0.4531	1.1676	1.6207
85	316.25	0.01761	5.168	286.39	897.8	1184.2	0.4587	1.1571	1.6158
90	320.27	0.01766	4.896	290.56	894.7	1185.3	0.4641	1.1471	1.6112
95	324.12	0.01770	4.652	294.56	891.7	1186.2	0.4692	1.1376	1.6068
100	327.81	0.01774	4.432	298.40	888.8	1187.2	0.4740	1.1286	1.6026
110	334.77	0.01782	4.049	305.66	883.2	1188.9	0.4832	1.1117	1.5949

TABLE D-1a
Properties of Dry Saturated Steam (continued)
Pressure

Abs press., psia	Temp., °F	Specific volume		Enthalpy			Entropy		
		Sat. liquid	Sat. vapor	Sat. liquid	Evap.	Sat. vapor	Sat. liquid	Evap.	Sat. vapor
P	t	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
120	341.25	0.01789	3.728	312.44	877.9	1190.4	0.4916	1.0942	1.5858
130	347.32	0.01796	3.455	318.81	872.9	1191.7	0.4995	1.0817	1.5812
140	353.02	0.01802	3.220	324.82	868.2	1193.0	0.5069	1.0682	1.5751
150	358.42	0.01809	3.015	330.51	863.6	1194.1	0.5138	1.0556	1.5694
160	363.53	0.01815	2.834	335.93	859.2	1195.1	0.5204	1.0436	1.5640
170	368.41	0.01822	2.675	341.09	854.9	1196.0	0.5266	1.0324	1.5590
180	373.06	0.01827	2.532	346.03	850.8	1196.9	0.5325	1.0217	1.5542
190	377.51	0.01833	2.404	350.79	846.8	1197.6	0.5381	1.0116	1.5497
200	381.79	0.01839	2.288	355.36	843.0	1198.4	0.5435	1.0018	1.5453
250	400.95	0.01865	1.8438	376.00	825.1	1201.1	0.5675	0.9588	1.5263
300	417.33	0.01890	1.5433	393.84	809.0	1202.8	0.5879	0.9225	1.5104
350	431.72	0.01913	1.3260	409.69	794.2	1203.9	0.6056	0.8910	1.4966
400	444.59	0.0193	1.1613	424.0	780.5	1204.5	0.6214	0.8630	1.4844
450	456.28	0.0195	1.0320	437.2	767.4	1204.6	0.6356	0.8378	1.4734
500	467.01	0.0197	0.9278	449.4	755.0	1204.4	0.6487	0.8147	1.4634
550	476.94	0.0199	0.8424	460.8	743.1	1203.9	0.6608	0.7934	1.4542
600	486.21	0.0201	0.7698	471.6	731.6	1203.2	0.6720	0.7734	1.4454
650	494.90	0.0203	0.7083	481.8	720.5	1202.3	0.6826	0.7548	1.4374
700	503.10	0.0205	0.6554	491.5	709.7	1201.2	0.6925	0.7371	1.4296
750	510.86	0.0207	0.6092	500.8	699.2	1200.0	0.7019	0.7204	1.4223
800	518.23	0.0209	0.5687	509.7	688.9	1198.6	0.7108	0.7045	1.4153
850	525.26	0.0210	0.5327	518.3	678.8	1197.1	0.7194	0.6891	1.4085
900	531.98	0.0212	0.5006	526.6	668.8	1195.4	0.7275	0.6744	1.4020
950	535.43	0.0214	0.4717	534.6	659.1	1193.7	0.7355	0.6602	1.3957
1000	544.61	0.0216	0.4456	542.4	649.4	1191.8	0.7430	0.6467	1.3897
1100	556.31	0.0220	0.4001	557.4	630.4	1187.7	0.7575	0.6205	1.3780
1200	567.22	0.0223	0.3619	571.7	611.7	1183.4	0.7711	0.5956	1.3667
1300	577.46	0.0227	0.3293	585.4	593.2	1178.6	0.7840	0.5719	1.3559
1400	587.10	0.0231	0.3012	598.7	574.7	1173.4	0.7963	0.5491	1.3454
1500	596.23	0.0235	0.2765	611.6	556.3	1167.9	0.8082	0.5269	1.3351
2000	635.82	0.0257	0.1878	671.7	463.4	1135.1	0.8619	0.4230	1.2849
2500	668.13	0.0287	0.1307	730.6	360.5	1091.1	0.9126	0.3197	1.2322
3000	695.36	0.0346	0.0858	802.5	217.8	1020.3	0.9731	0.1885	1.1615
3206.2	705.40	0.0503	0.0503	902.7	0	902.7	1.0580	0	1.0580

TABLE D-1b
Properties of Dry Saturated Steam *(continued)*
Temperature

Temp., °F	Abs. press., psia	Specific volume		Enthalpy			Entropy		
		Sat. liquid	Sat. vapor	Sat. liquid	Evap.	Sat. vapor	Sat. liquid	Evap.	Sat. vapor
t	p	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
32	0.08854	0.01602	330[illegible]	0.00	1075.8	1075.8	0.0000	2.1877	2.1877
35	0.09995	0.01602	294[illegible]	3.02	1074.1	1077.1	0.0061	2.1709	2.1770
40	0.12170	0.01602	2444	8.05	1071.3	1079.3	0.0162	2.1435	2.1597
45	0.14752	0.01602	2036.4	13.06	1068.4	1081.5	0.0262	2.1167	2.1429
50	0.17811	0.01603	1703.2	18.07	1065.6	1083.7	0.0361	2.0903	2.1264
60	0.2563	0.01604	1206.7	28.06	1059.9	1088.0	0.0555	2.0393	2.0948
70	0.3631	0.01606	867.9	38.04	1054.3	1092.3	0.0745	1.9902	2.0647
80	0.5069	0.01608	633.1	48.02	1048.6	1096.6	0.0932	1.9428	2.0360
90	0.6982	0.01610	468.0	57.99	1042.9	1100.9	0.1115	1.8972	2.0087
100	0.9492	0.01613	350.4	67.97	1037.2	1105.2	0.1295	1.8531	1.9826
110	1.2748	0.01617	265.4	77.94	1031.6	1109.5	0.1417	1.8106	1.9577
120	1.6924	0.01620	203.27	87.92	1025.8	1113.7	0.1645	1.7694	1.9339
130	2.2225	0.01625	157.34	97.90	1020.0	1117.9	0.1816	1.7296	1.9112
140	2.8886	0.01629	123.01	107.89	1014.1	1122.0	0.1984	1.6910	1.8894
150	3.718	0.01634	97.07	117.89	1008.2	1126.1	0.2149	1.6537	1.8685
160	4.741	0.01639	77.29	127.89	1002.3	1130.2	0.2311	1.6174	1.8485
170	5.992	0.01645	62.06	137.90	996.3	1134.2	0.2472	1.5822	1.8293
180	7.510	0.01651	50.23	147.92	990.2	1138.1	0.2630	1.5480	1.8109
190	9.339	0.01657	40.96	157.95	984.1	1142.0	0.2785	1.5147	1.7932
200	11.526	0.01663	33.64	167.99	977.9	1145.9	0.2938	1.4824	1.7762
210	14.123	0.01670	27.82	178.05	971.6	1149.7	0.3090	1.4508	1.7598
212	14.696	0.01672	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566
220	17.186	0.01677	23.15	188.13	965.2	1153.4	0.3239	1.4201	1.7440
230	20.780	0.01684	19.382	198.23	958.8	1157.0	0.3387	1.3901	1.7288
240	24.969	0.01692	16.323	208.34	952.2	1160.5	0.3531	1.3609	1.7140
250	29.825	0.01700	13.821	216.48	945.5	1164.0	0.3675	1.3323	1.6998
260	35.429	0.01709	11.763	228.64	938.7	1167.3	0.3817	1.3043	1.6860
270	41.858	0.01717	10.061	238.84	931.8	1170.6	0.3958	1.2769	1.6727
280	49.203	0.01726	8.645	249.06	924.7	1173.8	0.4096	1.2501	1.6597
290	57.556	0.01735	7.461	259.31	917.5	1176.8	0.4234	1.2238	1.6472
300	67.013	0.01745	6.466	269.59	910.1	1179.7	0.4369	1.1980	1.6350
310	77.68	0.01755	5.626	279.92	902.[illegible]	1182.5	0.4504	1.1727	1.6231
320	89.66	0.01765	4.914	290.28	894.[illegible]	1185.2	0.4637	1.1478	1.6115
330	103.06	0.01776	4.307	300.68	887.0	1187.7	0.4769	1.1233	1.6002
340	118.01	0.01787	3.788	311.13	879.0	1190.1	0.4900	1.0992	1.5891

TABLE D-1b
Properties of Dry Saturated Steam *(continued)*
Temperature

Temp °F	Abs press psia	Specific volume		Enthalpy			Entropy		
		Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor	Sat liquid	Evap	Sat vapor
t	P	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
350	134.63	0.01799	3.342	321.63	870.7	1192.3	0.5029	1.0754	1.5783
360	153.04	0.01811	2.957	332.18	852.2	1194.4	0.5158	1.0519	1.5677
370	173.37	0.01823	2.625	342.79	853.5	1196.3	0.5286	1.0287	1.5573
380	195.77	0.01836	2.335	353.45	844.6	1198.1	0.5413	1.0059	1.5471
390	220.37	0.01850	2.0836	364.17	835.4	1199.6	0.5539	0.9832	1.5371
400	247.31	0.01864	1.8633	374.97	826.0	1201.0	0.5664	0.9608	1.5272
410	276.75	0.01878	1.6700	385.83	816.3	1202.1	0.5788	0.9386	1.5174
420	308.83	0.01894	1.5000	396.77	806.3	1203.1	0.5912	0.9166	1.5078
430	343.72	0.01910	1.3499	407.79	796.0	1203.8	0.6035	0.8947	1.4982
440	381.59	0.01926	1.2171	418.90	785.4	1204.3	0.6158	0.8730	1.4887
450	422.6	0.0194	1.0993	430.1	774.5	1204.6	0.6280	0.8513	1.4793
460	466.9	0.0196	0.9944	441.4	763.2	1204.6	0.6402	0.8298	1.4700
470	514.7	0.0198	0.9009	452.8	751.5	1204.3	0.6523	0.8083	1.4606
480	566.1	0.0200	0.8172	464.4	739.4	1203.7	0.6645	0.7868	1.4513
490	621.4	0.0202	0.7423	476.0	726.8	1202.8	0.6766	0.7653	1.4419
500	680.8	0.0204	0.6749	487.8	713.9	1201.7	0.6887	0.7438	1.4325
520	812.4	0.0209	0.5594	511.9	686.4	1198.2	0.7130	0.7006	1.4136
540	962.5	0.0215	0.4649	536.6	656.6	1193.2	0.7374	0.6568	1.3942
560	1133.1	0.0221	0.3868	562.2	624.2	1186.4	0.7621	0.6121	1.3742
580	1325.8	0.0228	0.3217	588.9	588.4	1177.3	0.7872	0.5659	1.3532
600	1542.9	0.0236	0.2668	610.0	548.5	1165.5	0.8131	0.5176	1.3307
620	1786.6	0.0247	0.2201	646.7	503.6	1150.3	0.8398	0.4664	1.3062
640	2059.7	0.0260	0.1798	678.6	452.0	1130.5	0.8679	0.4110	1.2789
660	2365.4	0.0278	0.1442	714.2	390.2	1104.4	0.8987	0.3485	1.2472
680	2708.1	0.0305	0.1115	757.3	309.9	1067.2	0.9351	0.2719	1.2071
700	3093.7	0.0369	0.0761	823.3	172.1	995.4	0.9905	0.1484	1.1389
705.4	3206.2	0.0503	0.0503	902.7	0	902.7	1.0580	0	1.0580

Abs. press. psia (Sat. temp. °F)		Temperature °F											
		200	300	400	500	600	700	800	900	1000	1100	1200	1400
	v	392.6	452.3	512.0	571.6	631.2	690.8	750.4	809.9	869.5	929.1	988.7	1107.8
1	h	1150.4	1195.8	1241.7	1288.3	1335.7	1383.8	1432.8	1482.7	1533.5	1585.2	1637.7	1745.7
(101.74)	s	2.0512	2.1153	2.1720	2.2233	2.2702	2.3137	2.3542	2.3923	2.4283	2.4625	2.4952	2.5566
	v	78.16	90.25	102.26	114.22	126.16	138.10	150.03	161.95	173.87	185.79	197.71	221.6
5	h	1148.8	1195.0	1241.2	1288.0	1335.4	1383.6	1432.7	1482.6	1533.4	1585.1	1637.7	1745.7
(162.24)	s	1.8718	1.9370	1.9942	2.0456	2.0927	2.1361	2.1767	2.2148	2.2509	2.2851	2.3178	2.3792
	v	38.85	45.00	51.04	57.05	63.03	69.01	74.98	80.95	86.92	92.88	98.84	110.77
10	h	1146.6	1193.9	1240.6	1287.5	1335.1	1383.4	1432.5	1482.4	1533.2	1585.0	1637.6	1745.6
(193.21)	s	1.7927	1.8595	1.9172	1.9689	2.0160	2.0596	2.1002	2.1383	2.1744	2.2068	2.2413	2.3028
	v		30.53	34.68	38.78	42.86	46.94	51.00	55.07	59.13	63.19	67.25	75.37
14.696	h		1192.8	1239.9	1287.1	1334.8	1383.2	1432.3	1482.3	1533.1	1584.8	1637.5	1745.5
(212.00)	s		1.8160	1.8743	1.9261	1.9734	2.0170	2.0576	2.0958	2.1319	2.1662	2.1989	2.2603
	v		22.36	25.43	28.46	31.47	34.47	37.46	40.45	43.44	46.42	49.41	55.37
20	h		1191.6	1239.2	1286.6	1334.4	1382.9	1432.1	1482.1	1533.0	1584.7	1637.4	1745.4
(227.96)	s		1.7808	1.8396	1.8918	1.9392	1.9829	2.0235	2.0618	2.0978	2.1321	2.1648	2.2263
	v		11.040	12.628	14.168	15.688	17.198	18.702	20.20	21.70	23.20	24.69	27.68
40	h		1186.8	1236.5	1284.8	1333.1	1381.9	1431.3	1481.4	1532.4	1584.3	1637.0	1745.1
(267.25)	s		1.6994	1.7608	1.8140	1.8619	1.9058	1.9467	1.9850	2.0212	2.0555	2.0883	2.1498
	v		7.259	8.357	9.403	10.427	11.441	12.449	13.452	14.454	15.453	16.451	18.446
60	h		1181.6	1233.6	1283.0	1331.8	1380.9	1430.5	1480.8	1531.9	1583.8	1636.6	1744.8
(292.71)	s		1.6492	1.7135	1.7678	1.8162	1.8605	1.9015	1.9400	1.9762	2.0106	2.0434	2.1049
	v			6.220	7.020	7.797	8.562	9.322	10.077	10.830	11.582	12.332	13.830
80	h			1230.7	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3	1583.4	1636.2	1744.5
(312.03)	s			1.6791	1.7346	1.7836	1.8281	1.8694	1.9079	1.9442	1.9787	2.0115	2.0731
	v			4.937	5.589	6.218	6.835	7.446	8.052	8.656	9.259	9.860	11.060
100	h			1227.6	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8	1582.9	1635.7	1744.2
(327.81)	s			1.6518	1.7085	1.7581	1.8029	1.8443	1.8829	1.9193	1.9538	1.9867	2.0484
	v			4.081	4.636	5.165	5.683	5.195	6.702	7.207	7.710	8.212	9.214
120	h			1224.4	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2	1582.4	1635.3	1743.9
(341.25)	s			1.6287	1.6869	1.7370	1.7822	1.8237	2.8625	1.8990	1.9335	1.9664	2.0281
	v			3.468	3.954	4.413	4.861	5.301	5.738	6.172	6.604	7.035	7.895
140	h			1221.1	1275.2	1326.4	1376.8	1427.3	1478.2	1529.7	1581.9	1634.9	1743.5
(353.02)	s			1.6087	1.6683	1.7190	1.7645	1.8063	1.8451	1.8817	1.9163	1.9493	2.0110
	v			3.008	3.443	3.849	4.244	4.631	5.015	5.396	5.775	6.152	6.906
160	h			1217.6	1273.1	1325.0	1375.7	1426.4	1477.5	1529.1	1581.4	1634.5	1743.2
(363.53)	s			1.5908	1.6519	1.7033	1.7491	1.7911	1.8301	1.8667	1.9014	1.9344	1.9962
	v			2.649	3.044	3.411	3.764	4.110	4.452	4.792	5.129	5.466	6.136
180	h			1214.0	1271.0	1323.5	1374.7	1425.6	1476.8	1528.6	1581.0	1634.1	1742.9
(373.06)	s			1.5745	1.6373	1.6894	1.7355	1.7776	1.8167	1.8534	1.8882	1.9212	1.9831
	v			2.361	2.726	3.060	3.380	3.693	4.002	4.309	4.613	4.917	5.521
200	h			1210.3	1268.9	1322.1	1373.6	1424.8	1476.2	1528.0	1580.5	1633.7	1742.6
(381.79)	s			1.5594	1.6240	1.6767	1.7232	1.7655	1.8048	1.8415	1.8763	1.9094	1.9713
	v			2.125	2.465	2.772	3.066	3.352	3.634	3.913	4.191	4.467	5.017
220	h			1206.5	1266.7	1320.7	1372.6	1424.0	1475.5	1527.5	1580.0	1633.3	1742.3
(389.86)	s			1.5453	1.6117	1.6652	1.7120	1.7545	1.7939	1.8308	1.8656	1.8987	1.9607
	v			1.9276	2.247	2.533	2.804	3.068	3.327	3.584	3.839	4.093	4.597
240	h			1202.5	1264.5	1319.2	1371.5	1423.2	1474.8	1526.9	1579.6	1632.9	1742.0
(397.37)	s			1.5319	1.6003	1.6546	1.7017	1.7444	1.7839	1.8209	1.8558	1.8889	1.9510
	v				2.063	2.330	2.582	2.827	3.067	3.305	3.541	3.776	4.242
260	h				1262.3	1317.9	1370.4	1422.3	1474.2	1526.3	1579.1	1632.5	1741.7
(404.42)	s				1.5897	1.6447	1.6922	1.7352	1.7748	1.8118	1.8467	1.8799	1.9420
	v				1.9047	2.156	2.392	2.621	2.845	3.066	3.286	3.504	3.938
280	h				1260.0	1316.2	1369.4	1421.5	1473.5	1525.8	1578.6	1632.1	1741.4
(411.05)	s				1.5796	1.6354	1.6834	1.7265	1.7662	1.8033	1.8383	1.8716	1.9337
	v				1.7675	2.005	2.227	2.442	2.652	2.859	3.065	3.269	3.674
300	h				1260.0	1316.2	1368.3	1420.6	1472.8	1525.2	1578.1	1631.7	1741.0
(417.33)	s				1.5701	1.6268	1.6751	1.7184	1.7582	1.7954	1.8305	1.8638	1.9260
	v				1.4923	1.7036	1.8980	2.084	2.266	2.445	2.622	2.798	3.147
350	h				1251.5	1310.9	1365.5	1418.5	1471.1	1523.8	1577.0	1630.7	1740.3
(431.72)	s				1.5481	1.6070	1.6563	1.7002	1.7403	1.7777	1.8130	1.8463	1.9086
	v				1.2851	1.4770	1.6508	1.8161	1.9767	2.134	2.290	2.445	2.751
400	h				1245.1	1308.9	1362.7	1416.4	1469.4	1522.4	1575.8	1629.6	1739.5
(444.59)	s				1.5281	1.5894	1.6398	1.6842	1.7247	1.7623	1.7977	1.8311	1.8936

-WORKSHEET II-

ESTIMATED CRITICAL BORON CONCENTRATION

REFERENCE CONDITIONS: 532°F, 0% FP, No Xenon, No Control Rods, Equilibrium Samarium

1. Fuel Reactivity

a. Core Burnup 200 EFPD
b. Read Curve 3.1 of OP-103, Plant Curve Book.

(A) ____ % Δk/k

2. Xenon Reactivity (Use Step 2.1 or 2.2)

2.1 Value calculated by SAXON I (submit printout).
(____ % Δk/k) = (B) ____ % Δk/k

OR

2.2 a. Last power level was 100 % FP for 504 hrs.
b. Time Shutdown ____ hrs.
c. If time at last power level was < 40 hrs. and SAXON is unavailable, consult with Reactor Specialist.
(____ % Δk/k) = ____ % Δk/k

3. Samarium Reactivity Buildup After Shutdown

3.1 Value calculated by SAXON I (submit printout) ____ % Δk/k

4. Reactivity Effect From Temperature

a. Average RC Temperature 525 °F
b. Reference temperature is 532°F.
c. Temperature coefficient at ____ ppmB is obtained from Curve 3.6 of OP-103, Plant Curve Book, to be ____ x 10^{-2}% Δk/k/°F.
d. Reactivity = [T(ave) - 532] [Temp. Coeff.]
e. Reactivity = (____ - ____) (____ x 10^{-2}% Δk/k/°F) = (C) ____ % Δk/k

5. Reactivity of Control Rods at Desired Insertion

Groups 1-4 at	100 % WD		
Group 5 at	100 % WD		
Group 6 at	100 % WD		
Group 7 at	80 % WD	Regulating Group Worth	(D) ____ % Δk/k
Group 8 at	40 % WD	Group 8 Worth	____ % Δk/k

Calculated By ____ Date ____

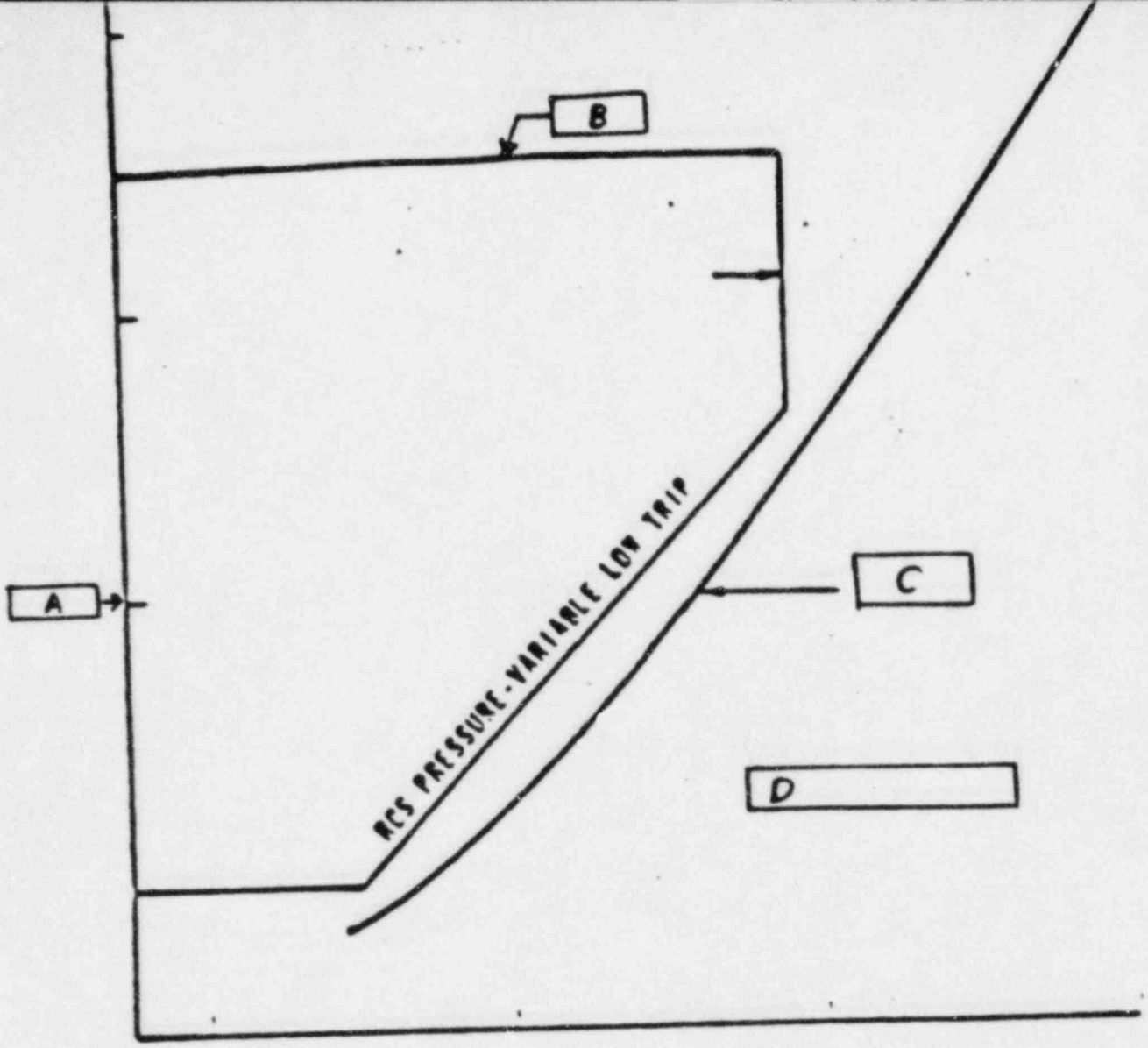


FIGURE 1

REACTOR CORE SAFETY LIMIT

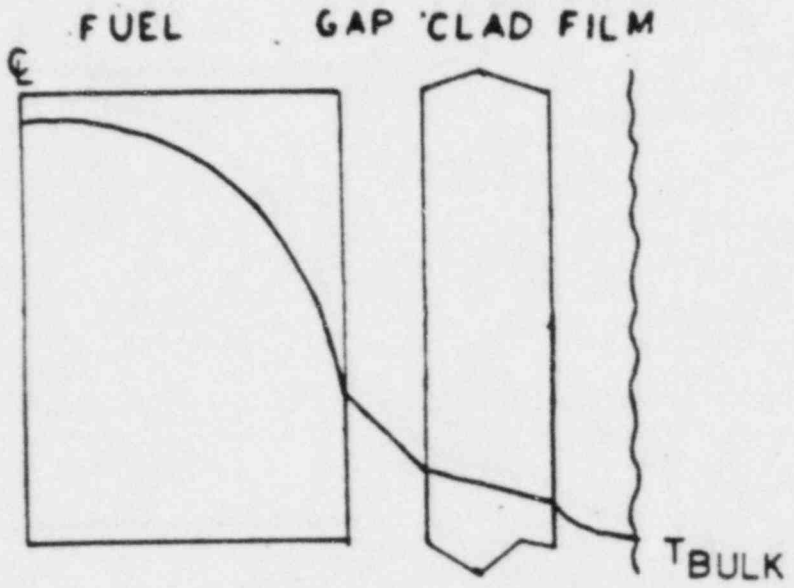
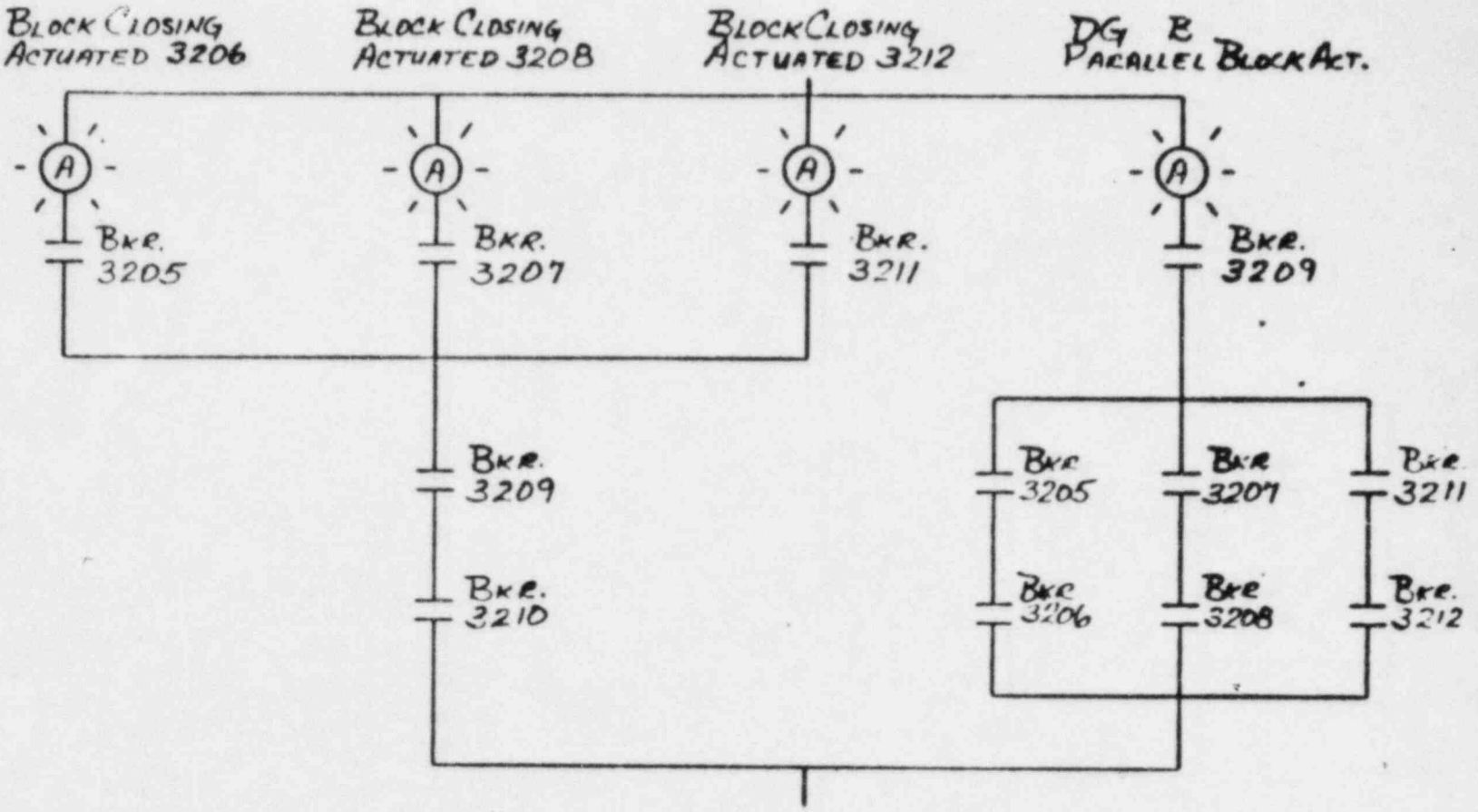


FIGURE 5.20


BLOCK CLOSING ACTUATED 3206
BLOCK CLOSING ACTUATED 3208
BLOCK CLOSING ACTUATED 3212
DG B PARALLEL BLOCK ACT.
A
BKR. 3205
BKR. 3207
BKR. 3211
BKR. 3209
BKR. 3209
BKR. 3210
BKR 3205
BKR 3207
BKR. 3211
BKR 3206
BKR 3208
BKR. 3212

REACTOR COOLANT SYSTEM

POWER OPERATED RELIEF VALVES

LIMITING CONDITION FOR OPERATION

3.4.3.2 The power operated relief valve (PORV) and its associated block valve shall be OPERABLE.

APPLICABILITY: MODES 1, 2, and 3.

ACTION:

a. With the PORV inoperable, within 1 hour either restore the PORV to OPERABLE status or close the associated block valve and remove power from the block valve; otherwise, be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

b. With the block valve inoperable, within 1 hour either restore the block valve to OPERABLE status or close the block valve and remove power from the block valve or close the PORV and remove power from the associated solenoid valve; otherwise, be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

c. The provisions of Specification 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.4.3.2.1 In addition to the requirements of Specifications 4.0.5, the PORV shall be demonstrated OPERABLE at least once per 18 months by performance of a CHANNEL CALIBRATION.

4.4.3.2.2 The block valve shall be demonstrated OPERABLE at least once per 92 days by operating the valve through one complete cycle of full travel.

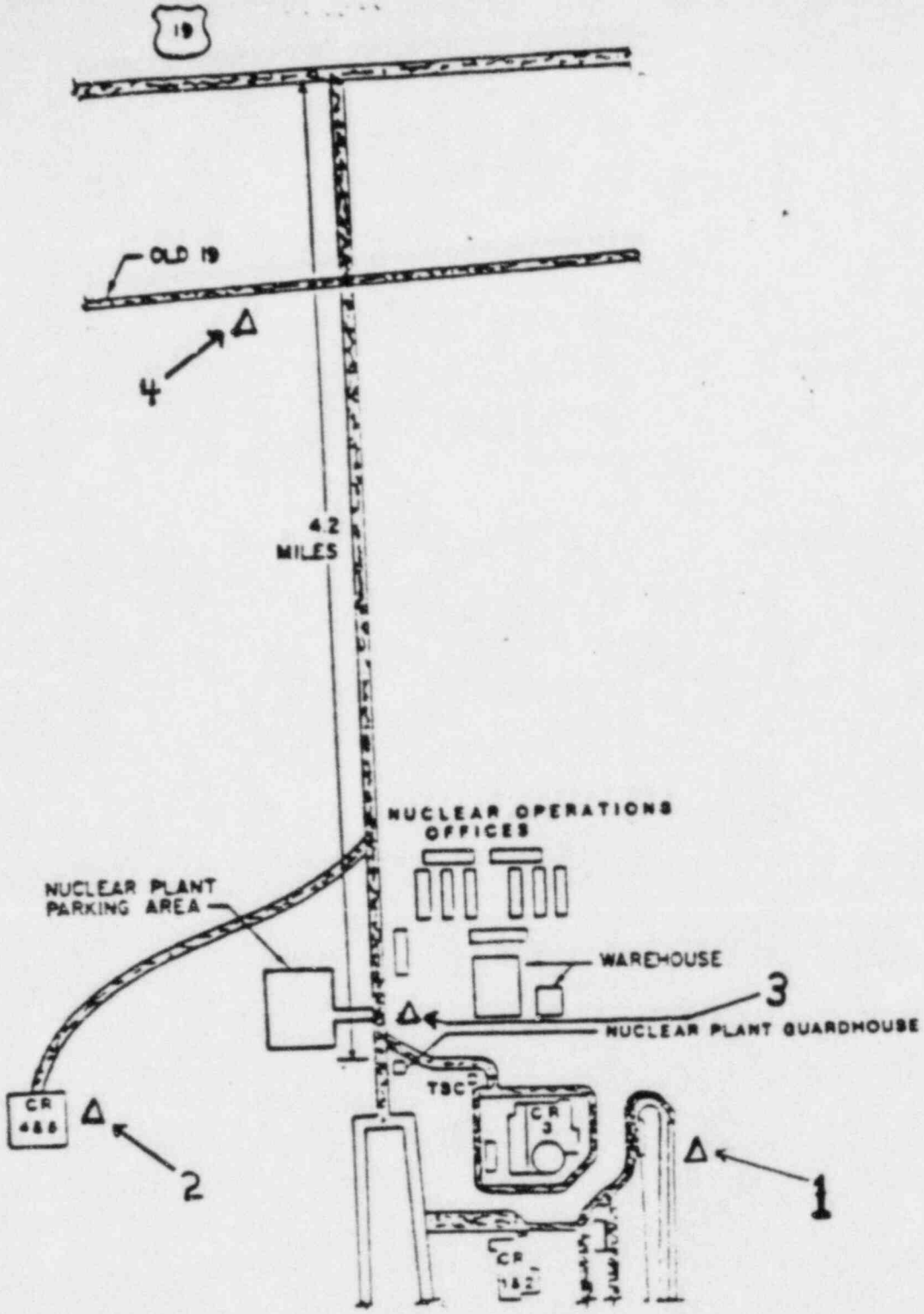

19
OLD 19
4
4.2
MILES
NUCLEAR OPERATIONS
OFFICES
NUCLEAR PLANT
PARKING AREA
WAREHOUSE
3
NUCLEAR PLANT GUARDHOUSE
TSC
CR
488
2
1

FIGURE 8.19

480V. ES MCC (3A-1)

250/125 V. DC BUS (3A)

120V A.C. VITAL BUS (3A)

FIGURE 2.19

ANSWERS 5.0 (25.0)

5.1 (b) (1.0)

Reference: NUS, NETRO, p. 11.4-3.

5.2 (c) (1.0)

Reference: NUS, NETRO, p 1.4-1

5.3 (d) (1.0)

Reference: GP, HTT and FFF, B3.3 p. 355

5.4 (b) (1.0)

Reference: STM-504

5.5 (b) (1.0)

Reference: 1. NUS, NETRO
2. Westinghouse Reactor Physics, Sect. 3, Neutron Kinetics and Sect. 5, Core Physics.

5.6 (c) (1.0)

Reference: NUS, NETRO, 10.3

5.7 (d) (1.0)

Ref: NUS - Plant Performance - pp 6.2-5 and 6.4 - 5

5.8 (d) (1.0)

Ref: NUS Plant Performance pp 6.4-5+6

5.9 (d) (1.0)

Ref: NUS Plant Performance, pp 3.3-2

5.10 (d) (1.0)

Reference: OP-210, p. 18

5.11 (b) (1.0)

Reference: T.S. pp B3/4 1-1

5.12 (d) (1.0)

Reference: T.S. pp 3/4 2-12

5.13 (a) (1.0)

Reference: OP-103 curves 4.7A, B, 4.8, 3.8A, B, C, D, 3.15A, 3.17 and STS 3/4 1-1.

5.14 ~~a. FALSE~~ delete ~~(0.5)~~

b. FALSE (0.5)

Reference: a. CR3 HTFF/Thermo, last page
b. AP-460 and AP-380

5.15 A - Core Outlet Pressure, psig or RCS pressure (2.0)
B - RCS - Pressure High Trip
C - Safety Limit ; or minimum DNBR limit (1.30)
D - Unacceptable Operation

Reference: T. S. Safety Limit Curve, pg 2-2

5.16 Answer: Zr - H2O Reaction (1.0)
Dissolved H2 in RCS
Radiolytic decomposition of Water any 2
Aluminum - NaOH reaction (.5 ea)

Reference: CR3 Draft HTFF/Thermo, Section 4, Post-LOCA H2 Sources.

5.17 Answer: (d) (1.0)

Reference: Power System Operation,
R. H. Miller, pg. 22-24

5.18 Answer: (c) (1.0)

Reference: Power System Operation,
R. H. Miller, pg. 22-23

5.19 Answer: (b) (1.0)

Reference: CR3 Draft HTFF/Thermo

5.20 Answer: (b) (1.0)

Reference: CR3 Draft HTFF/Thermo

5.21 Answer: (b) (1.0)

Reference: General Physics Corp. Academic Program for Nuclear Plant Personnel Vol. II Physics pg. 4-76, 77.

5.22 Answer: (c) (1.0)

Reference: CR3 Draft HTFF/Thermo

5.23 (2.0)

a. T - TS 3/4 2-1
b. F - TS 3/4 2-5 + 2-7 (and once per month)
c. F - TS 3/4 2-11
d. T - TS 3/4 B 2-1

ANSWERS 6.0 (25.0)

6.1 (1.0)

Answer: (d)

Reference: RB Isolation and Cooling System Lesson Plan, AND-91

6.2 (1.0)

Answer: (a)

Reference: AP-304, p. 4

6.3 (1.0)

Answer (a) (d)

Reference: STM-405 AND-91, P. 15.

(b) - (BSV-16 & 17 are normally open)
(c) - (Valves open on 4 psig, pumps start on 30 psig)
~~(d) -~~ (BSV-16 & 17 are normally open) But get an open signal

6.4 (1.0)

Answer: (b)

Reference: 1. STM 23-7
2. OP-502, p. 3
3. OP-408, Rev. 32

6.5 (1.0)

Answer: (a)

Reference: STM-17-12, 12, 10, 10.
(b) - Must be manually stopped
(c) - No auto position
(d) - Has auto start

6.6. (1.0)

Answer: (b)

Reference: STM 17-4, 4, 5, 7.
(a) - MUV-48 is remotely operated
(c) - Closes MUV-49, not 40 & 41
(d) - makeups demins may be parallel or series

6.7 (1.0)

Answer: (d)

Reference: STM-1-17 to 20

6.8 (1.0)

Answer: (b)

Reference: PASS Lesson Plan, RO-105

6.9 (2.0)

Answer: (See attached drawing)

1. Normal and bypass inverter supplies (0.5)
2. Inverter feed to vital (0.3)
3. DC to inverter (0.3)
4. Two normal battery chargers (0.3)
5. One back up battery charger (0.3)
6. Bypass transformer and switches (0.3)

6.10 (1.0)

Answer: (b)

Reference: Site Fire Protection Systems
ANAO-39

6.11 (1.0)

Answer: a. TRUE
Reference: AP-380, pg. 9 (0.5)

b. TRUE
Reference: OP-404, pg. 5 (0.5)

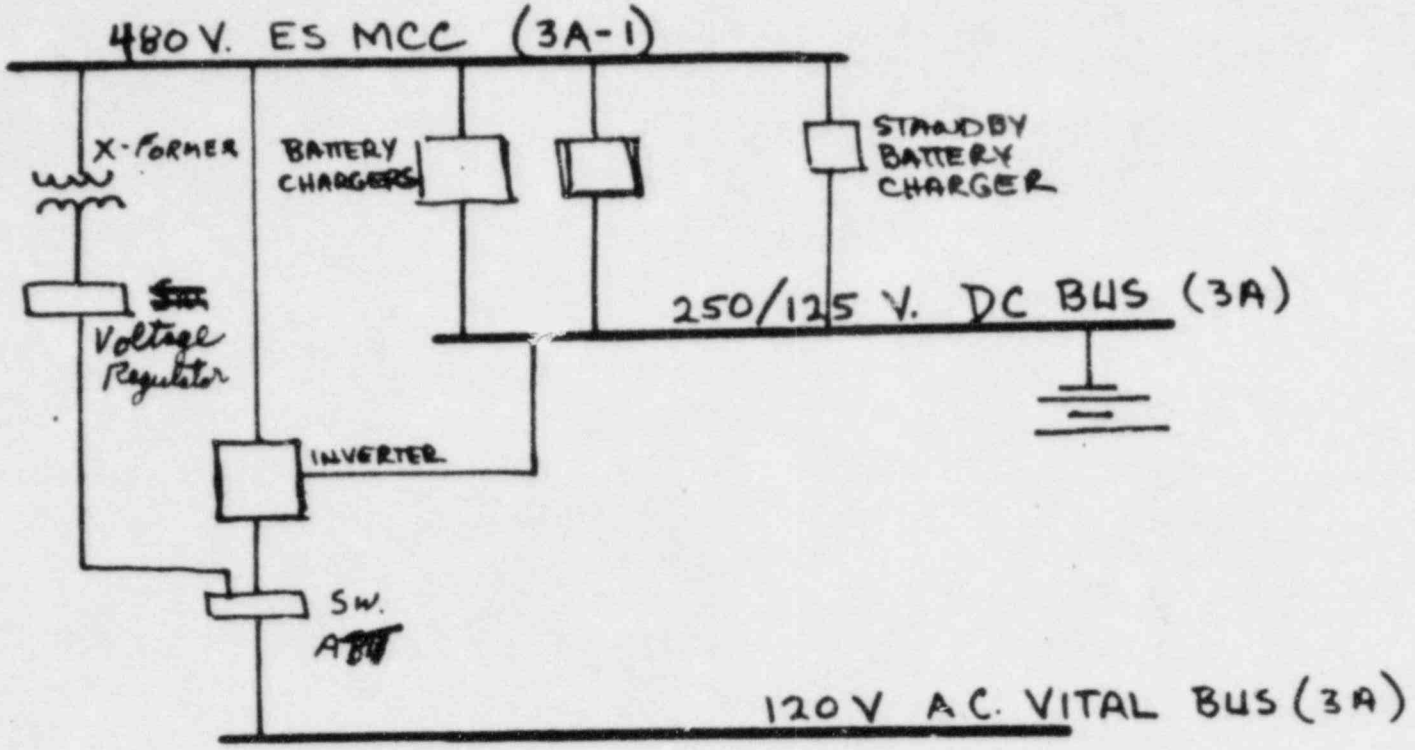

480 V. ES MCC (3A-1)
X-FORMER
BATTERY CHARGERS
STANDBY BATTERY CHARGER
Voltage Regulator
250/125 V. DC BUS (3A)
INVERTER
SW.
120 V A.C. VITAL BUS (3A)

FIGURE 2.19

6.12 a (1.0)

Ref: STM-20-2 (Separate Transmitters for DHV 3+4) OP-404, pg. 6, 7 (Alarm on DHV-41, no interlock)

6.13 b (1.0)

Ref: Steam Line Rupture Matrix Handout, pg. 5

6.14 b (1.0)

Ref: STM-6-15, 17

6.15 c (1.0)

Ref: STM-43-17

6.16 a (1.0)

Ref: STM-10-36, 37

6.17 d (1.0)

Ref: STM-9-11-21
Also T. S. pg. 2-6

6.18 b (1.0)

Ref: STM-10-56, 57

6.19 d (1.0)

Ref: STM-17-17, 18

6.20 a. Controlled bleed off temp. ≥ 170°F (Verified) (0.5)
High seal stage pressure drop ≥ 2/3 RCS pressure (0.5)

b. Total seal outflow exceeds 2.5 gpm (0.5)
and is <u>rapidly</u> increasing (0.5)

Ref: OP-302, Rev. 21, pg 5

6.21 (c)

Reference: TS 3/4 3-51
and 3-53 (1.0)

6.22 a. T - pg. 25 (0.5)
b. T - pg. 26 (0.5)
c. F - EM-207, Rev. 16, p. 16 (0.5)
d. F - TS 3/4 3-31 (0.5)

Reference: CR 3 Lesson Plan - Meterological Measurement System

7.0 ANSWERS (25.0)

7.01 a - 3 Ref. AP-241 (2.5)
b - 4 Ref. AP-242 (0.5 each)
c - 5 Ref. AP-243
d - 2 Ref. AP-244
e - 1 Ref. AP-245

7.02 Notify Aux. Building Operator to ensure closed: (0.5)

WDV-891, WDV-892

Ref. AP-272

7.03 (b) (d) (Establish OTSG levels w/MFP is a subseq. action) (1.0)

Ref. AP-330, Rev 1, 3/6/85

7.04 (d) (1.0)

NS Seawater Pumps - RWP-2A/2B (Step 3)
DH Seawater Pumps - RWP-3A/3B (Step 6)

Ref: AP-380
STM-20-9 (RWP-3A/3B)
STM-4-10 (ECCS)
STM-23-2/3 (NSCW)

7.05 Notify AB operator to open affected BKG at MCC: (1.0)

(° Reactor 3A2) Not req. for full credit
(° Reactor 3B2)

Ref: AP-380, pg 4

7.06 (3.0) (0.2 each)

a.	20	i.	100
b.	50	j.	low level limit (30")
c.	50	k.	50%
d.	1000	l.	95%
e.	20	m.	95%
f.	500	n.	0
g.	100	o.	2300
h.	10		

Ref: AP-380, pg.

7.07 (a) (1.0)

Ref: OP-404, Rev. 45, pgs. 4 and 5

7.08 (c) (1.0)

Ref: OP-404, Rev. 45, pgs 2 and 3

7.09 (a) (1.0)

Ref: OP-408, Rev. 32, pg 3
(Incorrect statements)
b - 12 psig
c - 15 sec.
d - 15 sec.

7.10 (c) (1.0)

Ref: OP-408, Rev. 32, Section 10.2

7.11 (b) (1.0)

Ref: OP-501, Rev. 8, pgs. 2, 3 and 6

7.12 (d) (1.0)

Ref: FP-203 Rev. 12, pg. 10

7.13 1. ZZ Tape has been read to verify that the grapple tube is fully up. (0.5)

2. ZZ Tape full up reading has been reported to the CCRO (0.5)

Ref: FP-203, Rev 12, pg 26

7.14 (b) (1.0)

Ref: FP-203, Rev. 12

7.15 (a) (1.0)

Ref: OP-504, Rev. 08, pg. 7

7.16 (d) (1.0)

Ref: OP-605 pg. 21
STM 27-37

7.17 (b) (1.0)

Ref: OP-402, Rev. 43, pg. 4

Rev 13. Step 5.10 " After a fuel assembly has been lifted by the "grapple Take up" light.

7.18 (c) (1.0)

Ref: RP-101, Rev. 19, pg. 9

7.19 (b) (1.0)

Ref: RP-101, Rev. 19, pg. 13

7.20 (d) (1.0)

Ref: RP-101, Rev. 19, pgs. 21 and 22

7.21 1. Announce over the PA system that the Control Center is being evacuated. (1.5)

2. Transfer the 6900V and 4160 unit buses from the unit auxiliary transformer to unit startup transformer.

3. Trip the reactor from the MCB or remotely by opening 480V CRD breakers "A" amd "B".

4. Depress "Reactor Trip" pushbotton AND perform Immediate Actions of AP-580.

5. Close FWV-161 and 162, EFW bypass valves.

6. Trip the main turbine and FWP's and assure EFWP's start and are controlling OTSG level.

Ref: AP-990

7.22 False (0.5)

Ref: AP-580 and EP-140

Answers 8.0 (25.0)

8.1 Answer: (c) (1.0)

Reference: AI-100, pg. 6, Rev. 7

8.2 Answer: (b) (1.0)

Reference: EM-202, page 29

8.3 Answer: (a) (1.0)

Reference: CR STS, page 3/4 4-18

b. not in TS Table 3.4-1
c. above transient limit
d. below SS limit

8.4 Answer: (d) (1.0)

Reference: AI-500, pages 2 & 3

8.5 Answer: (b) (1.0)

Reference: FP-203, page 2

8.6 Answer: (b) (1.0)

Reference: FP-203, page 7, Rev. 12

8.7 Answer: (c) (1.0)

Reference: CR STS pg. 3/4 1-5

8.8 Answer: (a) (1.0)

Reference: CR STS pg. 3/4 1-24, 25, 21 and 20

b. w/in to 5% (besides 2 hour action statement)
c. 24 hours
d. ± 6.5% in 2 hours

8.9 Answer: (b) (1.0)

Reference: CR STS pg. B 3/4 2-2, 3, 1 and 1.

8.10 Answer: (b) (1.0)

Reference: OSIM pg. IV-I

8.11 Answer: (d) (1.0)

Reference: OSIM, page III-2, Rev. 36

8.12 a. T - Ref: OSIM, III-9 (0.5)
b. T - Ref: OSIM, III-9 (0.5)
c. F - (shall not be amended) Ref: OSIM III-10 (0.5)
d. F - (shall not be issued for procedure changes) (0.5)
Ref: OSIM III-10

8.13 Answer: (b) (1.0)

Reference: TS page 1-3 and 1-4

8.14 Answer: (b) (1.0)

Reference: TS 3/4 4-4a

8.15 Answer: (d) (1.0)

Reference: TS page 3/4 7-7 and page B 3/4 7-2

8.16 Answer: (d) (1.0)

Reference: EM-202 pg. 1

8.17 Answer: (c) (1.0)

Reference: TS page 3/4 7-41

8.18 Answer: (b) (25% of 92 days) (1.0)

Reference: TS 3/4 0-2

8.19 Answer: (d) (1.0)

Reference: EM-205, pg. 10

8.20 Answer: (d) (1.0)

Reference: TS 3/4 3-26

8.21 Answer: 1. Issue a clearance per CP-115 (1.0)
2. Make a temporary change to an existing procedure.

8.22 Answer: The PRC shall approve any Clearance prior to issuance which meets any condition specified below: (2.0)

a. The Clearance is to be issued for an unusual, non-routine, or abnormal evolution (i.e., repair of RCV-11 in other than Mode 5 or 6, and other emergency repairs).

b. The Clearance to be issued cannot meet the double valve protection guidelines of 500 psig and/or 200°F and ≤ 1/2 inch in diameter opening.

c. The Clearance to be issued cannot meet the ES train separation criteria.

d. The Clearance to be issued cannot meet the limiting conditions for voluntarily entering a degraded mode of operation.

In addition to those items listed above, any questionable Clearance shall be forwarded to the PRC for approval prior to issuance.

Reference: CP-115

8.23 Answer: No, not capable of performing its intended function. (1.0)

Reference: TS page 1-1

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR REQUALIFICATION EXAMINATION

Facility: Crystal River Unit 3
Reactor Type: PWR B&W
Date Administered: May 14, 1985
Examiner: S. Lawyer
Candidate: _____

INSTRUCTIONS TO CANDIDATE:

Use separate paper for answers. Write answers on one side only. Staple question sheet on top of the answers sheets. Points for each question are indicated in parenthesis 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 four (4) hours after the examination starts.

Category Value	% of Total	Candidate's Score	% of Category Value	Category
25	25	_____	_____	1. Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow
25	25	_____	_____	2. Plant Design Including Safety and Emergency Systems
25	25	_____	_____	3. Instruments and Controls
25	25	_____	_____	4. Procedures - Normal, Abnormal, Emergency, and Radiological Control
100		_____		TOTALS

Final Grade _____ %

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

_____
Candidate's Signature

1.0 PRINCIPLES OF NUCLEAR POWER PLANT OPERATION, THERMODYNAMICS, HEAT TRANSFER AND FLUID FLOW (25.0)

1.1 Which one of the following CORRECTLY states the four contributors or factors that establish equilibrium xenon? (1.0)

a. Decay of xenon to Sm
Direct production from fission
Decay of iodine
Decay of xenon to Cs

b. Direct production from fission
Decay of iodine
Decay of xenon to Cs
Burnout by neutron absorption

c. Decay of iodine
Decay of xenon to Cs
Burnout by neutron absorption
Decay of xenon to Sm

d. Decay of xenon to Cs
Burnout by neutron absorption
Decay of xenon to Sm
Direct production from fission

1.2 The ratio of both Pu-239 and Pu-240 atoms to U-235 atoms changes over core life. Which one of the pairs of parameters below are most affected by this change? (1.0)

a. Moderator temperature coefficient and doppler coefficient

b. Doppler coefficient and beta

c. Beta and thermal neutron diffusion length

d. Thermal neutron diffusion length and moderator temperature coefficient

1.3 A moderator is necessary to slow neutrons down to thermal energies. Which of the following is the CORRECT reason for operating with thermal instead of fast neutrons? (1.0)

a. Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

b. Reactors operating primarily on fast neutrons are inherently unstable and have a higher risk of going prompt critical.

c. The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.

d. Doppler and moderator temperature coefficients become positive as neutron energy increases.

1.4 Which one of the following factors will help, rather than hinder, natural circulation? (1.0)

a. Lowering OTSG level

b. Lowering RCS pressure

c. Increasing RCS temperature

d. Lowering turbine bypass valve setpoint

1.5 Following a trip from full power with the reactor shutdown and 4 RCPs operating, the 125 psi bias is suddenly removed from the turbine bypass valves. Which one of the following statements best describes plant response? (1.0)

a. OTSG pressure drops and levels rise. The increased OTSG levels cause an overcooling of the RCS.

b. The OTSG saturation temperature drops causing a decrease in RCS T_c and a rapid drop in pressurizer level.

c. Since OTSG pressures drop 125 psi, BTU limit alarms will be received on both generators and feedwater will cut back.

d. The resulting cooldown of the RCS will decrease the shutdown margin to less than Tech Spec limits.

1.6 Sufficient reactivity is added to a shutdown reactor to cause the count rate to double. If the same amount of reactivity is added again which of the following is CORRECT? (1.0)

a. The count rate will double again.

b. The count rate will more than double but the reactor will still be subcritical.

c. The reactor will be critical or supercritical.

d. The source strength must be known to determine the new count rate.

1.7 During a xenon-free reactor startup, critical data was inadvertently taken two decades below the required Intermediate Range (IR) level (10^{-10} amps). The critical data was then taken at the proper IR level (10^{-8} amps). Assuming RCS temperature and boron concentrations did not change, which one of the following statements is CORRECT? (1.0)

a. The critical rod position taken at the proper IR level is LESS THAN the critical rod position taken two decades below the proper IR level.

b. The critical rod position taken at the proper IR level is THE SAME AS the critical rod position taken two decades below the proper IR level.

c. The critical rod position taken at the proper IR level is GREATER THAN the critical rod position taken two decades below the proper IR level.

d. There is not enough information given to determine the relationship between the critical rod position taken at the proper IR level and the critical rod position taken two decades below the proper IR level.

1.8 The reactor trips from full power, equilibrium xenon conditions. Twenty-four hours later the reactor is brought critical at 10^{-8} amps on the intermediate range. If power level is maintained at 10^{-8} amps for several hours, which of the following statements is CORRECT concerning control rod motion? (1.0)

a. Rods will have to be withdrawn due to xenon build-in.

b. Rods will have to be rapidly inserted since the critical reactor will cause a high rate of xenon burnout.

c. Rods will have to be inserted since xenon will closely follow its normal decay rate.

d. Rods will approximately remain as is as the xenon establishes its equilibrium value for this power level.

1.9 Which one of the following is CORRECT concerning starting of positive displacement (PD) and centrifugal pumps? (1.0)

a. Neither type of pump should be started with its discharge valve shut.

b. Both types of pumps should be started with their discharge valves shut.

c. A PD pump should be started with its discharge valve shut and a centrifugal pump started with its discharge valve open.

d. A PD pump should be started with its discharge valve open and a centrifugal pump started with its discharge valve shut.

1.10 Runout of a centrifugal pump is best characterized by which one of the following? (1.0)

a. high motor current, high flow rate and high discharge pressure.

b. low motor current, high flow rate and low discharge pressure.

c low motor current, low flow rate and high discharge pressure.

d. high motor current, high flow rate and low discharge pressure.

1.11 Which one of the following is the CORRECT order of the heat transfer processes as heat flux increases? (1.0)

a. bulk boiling, sub-cooled nucleate boiling, film boiling, DNB
b. sub-cooled nucleate boiling, bulk boiling, film boiling, DNB
c. bulk boiling, sub-cooled nucleate boiling, DNB, film boiling
d. sub-cooled nucleate boiling, bulk boiling, DNB, film boiling

1.12 With the main steam temperature and pressure at 600° F and 900 psia respectively, a main steam relief valve seat begins to leak to atmospheric pressure. The temperature of the steam three feet out of the relief valve is approximately: (1.0)

a. 600° F

b. 535° F

c. 444° F

d. 212° F

1.13 Concerning the behavior of Samarium-149, which of the following statements is CORRECT? (1.0)

a. Once equilibrium Sm is established, Sm reactivity does not change regardless of power level changes.

b. Equilibrium Sm reactivity at 50% power is equal to equilibrium Sm reactivity at 100% power.

c. Sm is only removed by radioactive decay.

d. Sm is produced by the decay of iodine.

1.14 Given the power history shown on Figure 2 attached, select the most accurate curve displaying the expected xenon history. (1.0)

a. 1
b. 2
c. 3
d. 4

Figure 2 – drawn on chalk board & numbers clarified

1.15 The reactor is being shutdown. A stable neutron population decay with a -78 second period (-1/3 DPM SUR) has been established. The intermediate range is reading 5E-8 amps. How long will it take before the source range high voltage cutoff bistable will reset? (1.0)

a. 4.5 minutes

b. 5.1 minutes

c. 6.0 minutes

d. 8.1 minutes

1.16 In performing an estimated critical boron concentration pursuant to OP-210, the attached worksheet is being utilized. Assuming the information shown on that sheet, which one of the following pairs of items will be positive (+)? (1.0)

a. A&D
b. B&D
c. B&C
d. A&C

1.17 Which one of the following statements about condenser vacuum is CORRECT? (1.0)

a. The pressure difference between the actual vacuum and absolute zero is termed condensate depression.

b. The vacuum prevents the steam entering the condenser from giving up its latent heat of vaporization, thereby increasing cycle efficiency.

c. The vacuum serves to allow more energy to be withdrawn from the steam in the turbine.

d. The vacuum prevents the condensed steam from becoming subcooled, thereby increasing cycle efficiency.

1.18 Which one of the following is NOT part of the accident postulated for the basis of the shutdown margin requirement? (1.0)

a. Main steamline break
b. Beginning-of-Life (BOL) condition
c. Tavg at no load operating temperature
d. Most reactive rod struck out

1.19 Which one of the following is NOT one of the DNB related parameters that must be maintained within Tech Spec limits? (1.0)

a. Hot leg temperature
b. Reactor Coolant pressure
c. Reactor Coolant flow rate
d. Axial power imbalance

1.20 Which of the following will NOT change over core life? (1.0)

a. The minimum acceptable shutdown margin

b. The acceptable flux imbalance band

c. The control rod reactivity worth

d. The power defect reactivity worth.

1.21 Which of the following statements about Net Positive Suction Head (NPSH) is INCORRECT? (1.0)

a. NPSH is the amount by which the suction pressure is greater than the saturation pressure for the water being pumped.

b. NPSH is essential for operation of centrifugal pumps but not for positive displacement pumps.

c. NPSH can be calculated by subtracting the saturation pressure from the actual suction pressure.

d. When a pump is started, the NPSH will decrease by the amount of the pressure drop in the suction piping.

1.22 TRUE or FALSE

delete

~~a. Following a LOCA, if HPI actuates and develops full flow, sufficient core cooling is ensured without the need for OTSG cooling, regardless of the size of the LOCA. (0.5)~~

b. Since the RCP Trip criteria is based on the SBLOCA analyses, you are not required to trip the RCPs following ES actuation due to a Main Steam Line Break Accident. (0.5)

1.23 Refer to Figure 1, "Reactor Core Safety Limit." Identify by name or title the parts of the Figure marked A, B, C, and D. (2.0)

1.24 Following an accident that results in excessive core damage, what are two significant sources of Hydrogen generation. (1.0)

END OF SECTION 1

2.0 PLANT DESIGN INCLUDING SAFETY AND EMERGENCY SYSTEMS (25.0)

2.1 Which of the following statements concerning the Reactor Building Isolation and Cooling System is CORRECT? (1.0)

a. Diverse Containment Isolation occurs when HPI is automatically or manually initiated.

b. Diverse Containment Isolation will isolate NSCCCW to the Reactor Coolant Pumps.

c. Diverse Containment Isolation will close the CI flow to the RB fans and open the SW valves.

d. When HPI automatically initiates, Diverse Containment Isolation occurs and the RB fans are started or shifted to slow speed.

2.2 The secondary cycle system is sampled for pH, Hydrazine, conductivity, oxygen, sodium and silica. Which one of the following will generate a computer alarm and lead you to initiate an Abnormal procedure for Secondary Chemistry Control? (1.0)

a. pH

b. Conductivity

c. Oxygen

d. Sodium

2.3 Many important pumps have annunciators which indicate when the pump is out-of-service, for example: ES Annunciator D-3-3 is labeled "DH Pump 'B' OUT OF SERV". Which one of the following is an indicated condition for this type of annunciator? (1.0)

a. No breaker DC control power.

b. Breaker control switch in normal after start, breaker open, breaker racked in.

c. Overload relay actuated.

d. Excessive motor amps.

2.4 Select the INCORRECT statement regarding the Condensate Injection System. (1.0)

a. Condensate injection is used for main turbine hood sprays, pump seals in the feedwater system, and valve ~~steam~~ stem sealing to prevent in-leakage of air to the condenser.

b. When condensate pressure is above 220 psig the condensate pumps are supplying seal and spray water.

c. If the discharge pressure decreases to ~200 psig, the G.W.P. that has been selected will start automatically.

d. The selector switch on the main control board, lines up the alternate G.W.P. for automatic start.

2.5 Which one of the following statements concerning the Reactor Coolant Pump design is CORRECT? (1.0)

a. An RCP motor may be started three times successively from ambient temperature, or four times from rated motor temperature.

b. An RCP motor may be started as many as three successive times regardless of temperature.

c. The pump is designed for continued operation on either loss of cooling water or loss of injection fluid, but not both.

d. The RCP must be secured immediately upon loss of seal injection OR loss of NSCCCW flow.

2.6 Which one of the following statements is accurate concerning the OTSG? (1.0)

a. Primary and secondary side blowdown (during plant heatup) is accomplished by means of drain connections near the lower tubesheet.

b. The startup range instruments will provide indication of flooding of the aspirating ports.

c. The auxiliary feedwater header penetrates near the top of the OTSG shell and sprays the feedwater on the upper cylindrical baffle.

d. Orifice plates, located in the lower downcomer section may be adjusted to balance out the internal circulation system.

2.7 During Long-term Post-Accident cooling, which one of the following flow paths is most desirable? (1.0)

a. Condition "A"; open drop line to RB Sump.

b. Condition "B"; Open auxiliary spray line to pressurizer.

c. Condition "C"; Combination of Conditions "A" and "B".

d. Condition "D"; Backflush with LPI Pump via open internal vent valves.

2.8 Which statement is CORRECT concerning the Core Flood (CF) System? (1.0)

a. Isolation valves CFV-5 and 6 receive an open signal following ES actuation even though they are required to be open with their breakers in the "Locked Reset" position.

b. During plant operation, the CF tank levels may be increased by adding from the makeup and purification (MUP) system and decreased by draining to the Auxiliary Building Sump.

c. When the breakers for CFV-5 and 6 are in "Locked Reset" position, they lose position indication in the control room.

d. During plant operation, high CF Tank pressure may be relieved by venting to the Reactor Building.

2.9 Which of the following statements concerning the Control Rod Drive System is INCORRECT? (1.0)

a. When the rotor assembly rotates, the leadscrew is kept from rotating by keying it to the torque tube through the torque taker.

b. Four ball check valves are installed at the base of the thermal barrier to permit in-flow to the CRD mechanism during a reactor trip.

c. The APSRs are prevented from tripping by physical restraints on the segment arms; this prevents the arms from pivoting outward.

d. The stator coils are sequentially energized in a repetitive 2-3-2-3 manner. When rod motion ceases, three coils remain energized.

2.10 Which one of the following correctly describes the trip system of the main turbine? (1.0)

a. When the auto-stop (turbine control) oil pressure decreases, the interface trip valve will open allowing the EHC Control oil to dump to drain.

b. When the EHC Oil pressure decreases, the interface trip valve will open, allowing the auto-stop (turbine control) oil to dump to drain.

c. The interface trip valve is solenoid actuated and when open, will dump both auto-stop (turbine control) oil and EHC control oil to drain.

d. A full turbine trip requires the servo valves for all four sets of turbine valves (throttle, governor, reheat and interceptor) to open.

2.11 With regard to the Reactor Building Spray System, which of the following statements is CORRECT? (1.0)

a. Upon receipt of an ES actuation signal of 4 psig in the RB, the NaOH tank outlet valves (BSV-11 and 12) will automatically stroke to the full open position.

b. A high RB pressure signal (30 psig increasing) starts the 2 RB spray pumps and automatically strokes open the suction valves (BSV-16 and 17).

c. The spray pumps start on the 4 psig signal while the spray header supply valves (BSV-3 and 4) stroke open on the 30 psig RB signal.

d. The 4 psig signal opens all three sets of valves (BSV-3 and 4, BSV-11 and 12, and BSV-16 and 17).

2.12 Select the CORRECT statement concerning the Nuclear Services Booster Pumps and CRD Cooling System. (1.0)

a. One pump is normally operated with the other serving as backup. A drop in line pressure (25 psi) will start the idle pump.

b. On an ES signal, the supply and return valves will close to the CRDM coolers and the booster pumps will have to be manually secured.

c. SWP-2A is powered from ES MCC 3A2 and SWP-2B is powered from ES MCC 3B2.

d. Low level in the SW surge tanks will trip the NS booster pumps.

~~2.13 With regard to the Plant Ventilation System, which one of the following Ventilation systems is required for emergency operation (an accident that causes ES actuation)? (1.0)~~

delete

~~a. Reactor Cavity Cooling Fans~~

~~b. Reactor Building Purge Supply System~~

~~c. Spent Fuel Cooling Pumps Air Handling Units~~

~~d. Reactor Building Operating Floor Fans~~

2.14 Select the CORRECT statement concerning the Makeup Pump Lube Oil System. (1.0)

a. If the main gear oil pump control switch is in Auto, the pump will start and run for three minutes after the makeup pump starts.

b. The backup gear oil pump will start (if in Auto) when oil pressure reaches 7 psig and will automatically stop when oil pressure reaches 20 psig.

c. If the main lube oil pump control switch is in Auto, the pump will start and run for three minutes after the makeup pump starts.

d. The backup lube oil pump has no auto start provisions and can be used as a back up for the gear oil system.

2.15 Select the CORRECT statement about the Makeup and Purification System. (1.0)

a. The block orifice has two bypasses, (MUV-51 and MUV-48) both of which are remotely operated from the control room.

b. The letdown line connections to the Decay Heat Removal System are prior to the prefilters and after the makeup filters.

c. A temperature element (TE-5) on the letdown line alarms at 130 °F and closes the letdown cooler outlet valves (MUV-40 and MUV-41) at 135 °F to protect the letdown coolers.

d. The deborating demineralizer may be operated in parallel or series with the makeup demineralizers.

2.16 The air start reservoirs for each emergency diesel will allow how many successive start attempts without recharging?

a. 3

b. 6

c. 9

d. 12

2.17 Which one of the following statements is CORRECT regarding the design of the internals vent valves? (1.0)

a. The vent valves are designed to open in the event of a hot leg break when the pressure differential reaches at least 43 psi.

b. The vent valves are designed to open in the event of a cold leg break when the pressure differential reaches at least 43 psi.

c. In the event of a hot leg break, the valves should begin to open with a ΔP of about 0.3 psid and be fully open at 1.5 psid.

d. In the event of a cold leg break, the valves should begin to open with a ΔP of about 0.3 psid and be fully open at 1.5 psid.

2.18 Which one of the following is NOT monitored for in the RANGE subsystem of the Post Accident Sampling System? (1.0)

a. High range noble gas

b. Hydrogen

c. Particulate

d. Iodine

2.19 On Figure 2.19, show the connections and components between the 480V MCC Safeguards Bus and a typical 120V A.C. Vital Bus. Include the following: Battery chargers, inverters, automatic and manual switches and transformers. It is not necessary to show breakers or to label components (the labels shown - 3A and 3A-1 are for illustration only). (2.0)

2.20 Select the CORRECT statement concerning the 250/125 VDC System. (1.0)

a. All battery chargers have a 125V DC output even though some DC buses are rated for a 250V DC output.

b. Only one battery charger is required to maintain a full charge on its respective bus.

c. The equalizing charge (137VDC) is below the high alarm setpoint (140 VDC), i.e. when on equalizing charge, a high voltage alarm should not be indicated.

d. Low battery electrolyte level is indicated by an annunciator alarm in the control room.

2.21 Which one of the following FW booster pump parameters is in both the FW booster pump trip logic and the permit light logic? (1.0)

a. Lube oil pressure

b. Ground overcurrent

c. Phase overcurrent

d. Bus undervoltage

2.22 Select the CORRECT statement concerning the site fire protection systems. (1.0)

a. All areas protected by a fixed water spray system use heat detectors to actuate the alarms.

b. To prevent accidental actuation, it requires two detectors actuating to cause operation of the fixed water spray system on the charcoal filter banks.

c. A wet pipe sprinkler system is used to protect the Emergency Diesel Generators.

d. Lube oil systems on the reactor coolant pumps, feedwater pumps, and main turbine are protected by a fixed water sray system.

2.23 List TWO conditions that will prevent the turbine bypass valves from dumping main steam to the condenser. (1.0)

2.24 TRUE or FALSE

a. Maximum flow for one HPI pump is approximately 540 gpm @ 600 psig. (.5)

b. LPI pump high flow alarm is about 3400 GPM and runout flow about 4100 GPM. (.5)

END OF SECTION 2

3.0 INSTRUMENTS AND CONTROLS (25.0)

3.01 Which one of the following load limiting conditions and corresponding load limit is CORRECT for an Asymmetric Rod? (1.0)

a. 30%/min to maximum limit of 75%.

b. 30%/min to maximum limit of 60%.

c. 20%/min to maximum limit of 75%.

d. 20%/min to maximum limit of 60%.

3.02 If the Diamond or Reactor Demand Stations are in HAND, the feedwater system will accept responsibility for control of Tave only if certain conditions are met. Of the following conditions that will prevent feedwater from controlling Tave, which one is stated CORRECTLY? (1.0)

a. Either steam generator high level limited.

b. Either steam generator low level limited.

c. Either steam generator BTU limited.

d. Either loop A or B hand/auto station in manual.

3.03 Which one of the following statements concerning the Control Rod Drive Position Indication System is CORRECT? (1.0)

a. The 0% switch is located 1.5 inches below the in-limit switch.

b. The 100% switch is located 1.5 inches above the out-limit switch.

c. The first rod in any group to reach the out-limit switch will stop further travel of all rods in that group.

d. A key switch in the control room can bypass the group 7 out-limit of 91.4% withdrawn.

3.04 Which of the following Decay Heat System Interlocks is CORRECT? (1.0)

a. Separate RC pressure transmitters will shut DHV-3 and DHV-4 at approximately 284 psig.

b. Separate RC pressure transmitters will shut DHV-3, DHV-4 and DHV-41 at approximately 284 psig.

c. A single RC pressure transmitter will shut DHV-3 and DHV-4 at approximately 284 psig.

d. A single RC pressure transmitter will shut DHV-3, DHV-4, and DHV-41 at approximately 284 psig.

3.05 Select the CORRECT statement concerning the interlocks on the low load feedwater valves. (1.0)

a. Low load feedwater control valves begin to ramp open when the respective low load block valves reach their 80% open position.

b. Low load feedwater block valves open when the main feedwater block valves shut.

c. Low load feedwater block valves shut when the low load control valves reach the 80% closed position.

d. Low load feedwater control valves begin to ramp open when the respective startup control valves open to their approximate 90% open position.

3.06 Which of the following statements is INCORRECT regarding bypassing the Steam Line Rupture Matrix? (1.0)

a. During a normal cooldown, when OTSG pressure drops below 725 psig, the matrix can be bypassed by depressing two bypass pushbuttons on the main control board.

b. During a normal cooldown, the four maintenance bypass key switches must be utilized before the operator can depress the two bypass pushbuttons.

c. Following an actuation, if either the < 725 or < 600 pressure switch has actuated, a bypass permit will be present.

d. Following an actuation, in addition to a bypass permit, the operator must depress the two main control board push buttons in order to bypass the matrix.

3.07 Which one of the following statements is CORRECT concerning the reset pushbuttons for the Steam Line Rupture Matrix System.? (1.0)

a. The reset pushbutton will reset the actuation, not the bypass.

2. If the reset pushbuttons are pressed when the Matrix is bypassed below 600 psig, the Matrix will actuate.

3. During heatup, the reset pushbuttons must be depressed in order to reset the Matrix once OTSG pressure increases to > 725 psig.

4. If the Maintenance Bypass Keys are in "Maint." position, the Reset Pushbuttons have no affect.

3.08 Which of the following statements is CORRECT concerning the Intermediate Range Compensated Ionization Chambers? (1.0)

a. The detectors are surrounded by four inches of lead for shielding fast neutron radiation.

b. The boron lined chamber is sensitive to neutron and gamma radiation while the unlined chamber is sensitive only to gamma rays.

c. The compensated ion chamber is designed to remove the gamma signal only at high reactor power levels.

d. Undercompensation will cause loss of some neutron current as well as blocking gamma current.

3.09 Which of the following statements is CORRECT concerning the operation of a typical Atmospheric Radiation Monitor (for example, RM-A1 or A2)? (1.0)

a. The air sampled will pass through a fixed particulate filter. The particulate buildup on the filter is then measured by a GM detector which outputs the measurement in CPM.

b. After passage through the particulate filter the air is drawn into a gas sampler which detects gaseous activity with a scintillation detector.

c. A gamma scintillation detector is used to measure the iodine activity on a fixed iodine filter (activated charcoal).

d. The flow path of the sampled air through RM-A2 is the particulate filter, the gas sampler, followed by the iodine filter.

3.10 Select the CORRECT statement concerning the Area Radiation Monitoring Subsystem. (1.0)

a. All of the channels, RM-G1 through RM-G19, use G-M detectors.

b. All of the channels, RM-G1 through RM-G19 use a Sr-90 check source.

c. To check the WARNING and HIGH setpoints you must first turn the Alarm Reset/Operate/Check Source Switch to the Alarm Reset position.

d. To set the WARNING or HIGH alarms you must first turn the Warning/Operate/High switch to either the WARNING or HIGH position then adjust the appropriate internally mounted Alarm setting control shaft.

3.11 Adjustments are made to the Power Range Nuclear Instruments as determined by Heat Balances. Power gain adjustments are made to which one of the following modules? (1.0)

a. Linear amplifer

b. Bistable

c. Summing amplifier

d. Difference amplifier

3.12 Which of the following is CORRECT concerning the Rod Withdrawal interlocks from the Source and Intermediate Channels? (1.0)

a. A SUR signal from the source range halts rod withdrawl when the SUR exceeds 2 DPM. This is reset at 1 DPM.

b. A SUR signal from the intermediate range halts rod withdrawl when the SUR exceeds 2 DPM. This is reset at 1 DPM.

c. At > 10^{-9} amps, NI-3 or NI-4 will bypass the source range rod withdrawl prohibit.

d. At > 10^{-9} amps, NI-3 and NI-4 will bypass the source range rod withdrawl prohibit.

3.13 When synchronzing the generator to the grid, OP-203, "Plant Startup" directs the operator to regulate turbine speed to slowly rotate the synchroscope in the fast (clockwise) direction. Which choice below CORRECTLY gives the two parameters that the synchroscope is indicating? (1.0)

a. Current and voltage differences

b. Current and frequency differences

c. Voltage and phase differences

d. Frequency and phase differences

3.14 Which one of the following statements is CORRECT concerning the paralleling of electrical systems? (1.0)

a. Although it is desireable to have speed and phase position matched, it is much more important to have voltages matched.

b. If voltages are not matched at the time the synchronizing switch is closed, there will be VAR flow from the lower voltage source to the higher one.

c. If the incoming machine is at synchronous speed but out of phase with the running when the breaker is closed, heavy currents will flow to either accelerate or retard the incoming machine.

d. If the incoming machine is in phase but slightly faster than synchronous speed when paralleled, the system will tend to speed up the incoming machine to synchronous speed.

3.15 Select the CORRECT statement with regard to speed control (Governor) of the Emergency Diesel Generators. (1.0)

a. As a general rule, D-G units running alone should have the SPEED DROOP control set on 0 (zero).

b. The synchronizer motor, mounted on top of the governor, allows the operator to match the voltage of the D-G with running voltage before synchronizing to the system.

c. The LOAD LIMIT control may be used for shutting down the diesel by turning the LOAD LIMIT control to zero.

d. The SYNC INDICATOR, located directly below the SYNCHRONIZER control indicates if the D-G is in phase with the system.

3.16 When the RPS is in Shutdown Bypass, which one of the following is CORRECT? (1.0)

a. A high pressure trip of 1720 psig is administratively imposed and an overpower trip of 5% automatically imposed.

b. The high pressure trip at 2355 psig is bypassed.

c. The four trips bypassed are high temperature, low pressure, variable low pressure and flux/delta flux/flow.

d. The RCP Power Monitor trip is bypassed.

3.17 Which one of the following statements is CORRECT concerning the Overspeed Protection Control (OPC) of the main Turbine? Assume the OPC is in the "In Service" position. (1.0)

a. At 103%, only the governor and interceptor valves will close.

b. At 103%, all valves - Throttle, governor, reheat and interceptor, will close.

c. At 111%, the OPC will close only the governor and interceptor valves will close.

d. At 111%, the OPC will close all valves - throttle, governor, reheat and interceptor, will close.

3.18 Cross-Tie Blocking Interlocks are provided to prevent paralleling of both D-G. Refer to Figure 3.18 and select the CORRECT statement. (1.0)

a. If breakers 3209, 3210 and 3205 are all closed, the amber lamp (Block Closing Actuated 3206) will be lit, thus permitting breaker 3206 to be closed.

b. If breakers 3209 and (i) 3205 and 3206, or (ii) 3207 and 3208, or (iii) 3211 and 3212 are closed, the amber lamp (DG Parallel Block Act) will be lit and breaker 3210 can not be closed.

c. If the amber lamp (Block Closing Actuated 3208) is lit, it means breaker 3208 cannot be closed because the 3B bus is already being fed from the 3A bus (through 3207) and no Diesels are running.

d. If both Diesels are feeding their respective buses (3209 closed and 3210 closed) all Block Closing Actuated Lamps will be lit.

~~3.19 Select the INCORRECT statement concerning the Pressurizer Heater controls. (1.0)~~

~~a. Heater bank A, B and C use modulating control (SCRs), while banks D and E are strictly on/off control.~~

~~b. If pressurizer level decreases to less than 30 inches, all heater banks will be de-energized.~~

~~c. Bank C has four groups of heaters which are sequenced on to prevent two groups in the same bank from coming on simultaneously.~~

~~d. Banks A and B contain only one group of heaters, have no staggered turn on, and are both fully on at 2135 psig.~~

3.20 Which of the following is CORRECT concerning OTSG level instruments? (1.0)

a. The startup range (0-250") and the Operate Range (0-100%) share the same upper and lower level instrument taps.

b. If a startup level transmitter fails low while at power, there will be no noticeable effect on the ICS (all subsystems in auto).

c. The operate range is temperature compensated by the lower downcomer temperature.

d. The startup range has a low level input to the ICS and is temperature compensated.

3.21 Which one of the following is CORRECT concerning the "Air Fail Reset" pushbuttons for MUV-16, 31 and 51? (1.0)

a. The pushbutton only indicates loss of air to the associated valve E/P controller.

b. The pushbutton indicates loss of air to E/P controllers for MUV-16 and 51 and also loss of air to the valve positioner for MUV-31.

c. On loss of air supply, the solenoid valve supplying air to the air lock valve will de-energize, causing the affected valve (16, 31 or 51) to close.

d. When air pressure has increased, depressing the air fail reset pushbutton will unlock MUV-16, 31 or 51.

3.22 List five of the seven interlocks required to start a Reactor Coolant pump. Include setpoints where applicable. (2.0)

3.23 a. What two control room indications of abnormal RCP operation, require the pump to be shutdown immediately? (1.0)

b. What control room indication of abnormal RCP operation, requires power level to be reduced to 72%, at 30%/min, then tripping the affected RCP? (1.0)

END OF SECTION 3

4.0 PROCEDURES - NORMAL, ABNORMAL, EMERGENCY AND RADIOLOGICAL CONTROL (25.0)

4.01 Match the Condition with the appropriate Radiation Monitor Alarm. (2.5)

Radiation Monitor	Condition
a. RM-A1	1. Control complex ventilation return air has exceeded setpoint on gas or iodine/particulate channels.
b. RM-A2	2. Possible spent fuel radioactivity leak.
c. RM-A3	3. Reactor Building purge duct exhaust to the atmosphere has exceeded setpoint on gas channel.
d. RM-A4	4. Auxiliary Building ventilation exhaust to the atmosphere has exceeded setpoint on gas channel.
e. RM-A5	5. Possible waste gas tank or piping leak.

4.02 List your Immediate Actions in response to an alarm from RM-L2. (0.5)

4.03 Which of the following is NOT an Immediate Action required in AP-330, "Loss of Nuclear Services Water". (1.0)

a. Trip all NSCCCW pumps: SWP-A, SWP-B, SWP-C, SWP-2A, SWP-2B.

b. Establish OTSG levels with emergency feedwater pumps.

c. Trip reactor AND refer to AP-580

d. Close: MUV-50 and MUV-51

4.04 Immediate Action step 3 of AP-380, "Engineered Safeguards System Actuation," states the following:

Ensure HPI trains start
- 2 HPI pumps
- SWPs
- RWPs

Step 6 of the same procedure states:

Ensure LPI trains start
- DHPs
- DCPs
- RWPs

Which statement is CORRECT concerning the "RWPs" referred to in AP-380? (1.0)

a. The RWPs in step 3 and step 6 are the same. The verification is repeated to ensure it is accomplished.

b. The RWPs in Step 3 refer to RWP-3A and 3B; the RWPs in Step 6 refer to RWP-2A and 2B.

c. Step 3 refers to RWP-1, 2A and 2B while step 6 refers only to RWP-2A and 2B.

d. In Step 3, the RWPs are the Nuclear Services (Emergency) Seawater Pumps while in Step 6, RWPs refer to the Decay Heat (Emergency) Seawater Pumps.

4.05 An Immediate Action of AP-380, "Engineered Safeguards System Actuation," is to:

"Place RB sump pump in PULL-TO-LOCK":

- WDP-2A
- WDP-2B

What is the Remedial Action associated with this step? (1.0)

4.06 The statements below are contained in AP-380, "Engineered Safeguards System Actuation." Fill in the blanks with the appropriate numbers where indicated. (3.0)

When the following conditions exist:

° High Pressure

- Adequate subcooling margin; (a) °F when > 1500 psig
  (b) °F when ≤ 1500 psig

- PZR level ≥ (c)"
- OTSG heat removal

OR

° Low pressure

- LPI flow ≥ (d) GPM in each train and stable for ≥ (e) minutes, Then STOP HPI.

- If TC < (f) °F, then refer to EP-220

° Required Cooldown Rates

Normal	≤ (g) °F/hr
Natural Circulation	(h) °F/hr

MUV-53 and MUV-257 (recirc valves) must be open when total HPI flow ≤ (i) GPM

Establish required OTSG level

° Any RCP operating	(j) "
° No RCP's, adequate subcooling margin	(k) %
° Less than adequate subcooling margin	(l) %
° < 2 HPI pumps available	(m) %

° If subcooling margin < (n), then go to EP-290.

° When RC Press ≥ (o) psig, then open PORV.

4.07 Select the INCORRECT statement for the following Limit and Precaution as contained in OP-404, Decay Heat Removal System. (1.0)

"In order to assure that redundant or diverse DHR methods are available during all modes of operation, the following requirements must be met prior to removing a DH train from service."

a. The LPI pump suction valves from BWST (DHV-34 and DHV-35) will be closed and the breakers racked out during periods when the BWST is empty and a BAST is being utilized for emergency boration control.

b. No more than one DH train shall be removed from service at any one time.

c. The requirements for voluntarily entering a degraded mode of operation listed in CP-115 have been met.

d. The refueling transfer canal is flooded, or at least one OTSG is available for cooling either by forced flow or natural circulation, or there is a readily accessible source of borated water during periods of low DH load and the plant is in Mode 5 or 6.

4.08 Which of the following statements are CORRECT concerning DH pump operation in the recirculation mode? (1.0)

a. As long as the minimum flow rate of 80 gpm is not violated, DH pump operation in the recirculation mode is unrestricted.

b. In no event shall the DH pump operate in the recirculation mode continuously for 24 hours or greater than 72 hours per month.

c. DH pump operation in the recirculation mode shall be timed and an entry made in the Control Center notebook.

d. The maximum flow from the DH system to the MUP is restricted to 140 gpm when the DH pumps are in the recirculation mode.

4.09 Select the CORRECT statement concerning the Nuclear Services Cooling System (as per OP-408). (1.0)

a. When SW system pressure drops to 110 psig, SWP-1B automatically starts.

b. When RW system pressure drops to 110 psig, RWP-2B automatically starts.

c. When either emergency SW pump starts, the normal pump will trip in 30 seconds.

d. When either emergency RW pump starts, the normal pump will trip in 30 seconds.

4.10 Where would you expect to find the correct procedure to transfer cooling water for the 3A and 3C makeup pumps from the DC System to the SW System? (1.0)

a. OP-402, Makeup and Purification System

b. OP-705, Emergency Power-DC System

c. OP-408, Nuclear Services Cooling System

d. All three of the above procedures contain these instructions.

4.11 Select the CORRECT statement concerning transfer of Non-Nuclear Instrumentation signals to the ICS (as per OP-501). (1.0)

a. Disconnecting the RC flow signal source from the RPS cabinets has no affect on the ICS.

b. If operating signal source malfunctions make signal source transfer necessary, the transfer to another source should be done immediately regardless of ICS operating mode.

c. When changing narrow range RC pressure signals, the PORV (RCV-11) should be open, with the heaters and spray valves in manual.

d. Buffer cards or buffer card modules may be replaced while leaving the affected controllers in auto.

4.12 Select the CORRECT Limit and Precaution concerning the Control Rod Drive System (as per OP-502). (1.0)

a. Maximum stator temperature is 200°F with CRD energized.

b. Minimum reactor power for placing the ICS reactor demand station in auto is 5%.

c. If a Safety Group is backed away from its "Out-limit" the Diamond must be in auto to enable Dilute Signal #1.

d. The "Auto" mode cannot be selected with "Sequence Inhibit" indicated.

4.13 Which of the following statements is CORRECT concerning the temperature of the cooling water supplied to the CRD's? (1.0)

a. Maximum allowable temperature is 180°F, there is no minimum temperature.

b. Maximum allowable temperature is 180°F, the minimum is 10°F above the dew point at the RV head.

c. Maximum allowable temperature is 120°F, there is no minimum temperature.

d. Maximum allowable temperature is 120°F, the minimum is 10°F above the dew point at the RV head.

4.14 Which of the following statements is CORRECT concerning the ICS Limits and Precautions? (1.0)

a. If a feedwater cross-limit occurs while controlling the reactor from either the reactor demand or Diamond station, increase reactor power to be compatible with total feedwater flow.

b. If a feedwater cross-limit occurs while controlling the reactor from either the reactor demand or Diamond stations, decrease reactor power to be compatible with total feedwater flow.

c. If a reactor cross-limit occurs while controlling both feedwater demand control stations in hand, reduce the reactor power to be compatible with total feedwater flow.

d. If a reactor cross-limit occurs while controlling both feedwater demand control stations in hand, increase the reactor power to be compatible with total feedwater flow.

4.15 Which of the following statements is CORRECT concerning operation of the turbine bypass valves? (1.0)

a. If automatic operation of turbine bypass valves is desired when CRD breakers are open, set turbine header pressure controller to 27% to compensate for +125 psig reactor trip bias.

b. If automatic operation of turbine bypass valves is desired when CRD breakers are open, the ±50 psig throttle pressure error logic must be bypassed.

c. If automatic operation of turbine bypass valves is desired when CRD breakers are open, the ULD must be less than 15% to reset the +50 psig bias.

d. Automatic operation of turbine bypass valves is not possible without first resetting the CRD trip breakers.

4.16 In order to startup a main feedwater pump, (Section 11.3 of OP-605) you must depress and hold the "Speed Signal Bypass" push button. After which of the following steps can you release the "Speed Signal Bypass" without causing the FW Pump Turbine to Trip? (1.0)

a. Verify all white "Permit" lights and speed control at "minimum" with green light on governor speed control switch.

b. Place "Trip/Reset" switch in "Reset" position

c. Verify the following occurs:

LP Stop Open
HP Stop Open

d. Verify turbine speed greater than 100 RPM

4.17 During all evolutions involving the makeup pumps, verify operable flow paths for each pump to be operated. Loss of flow through a makeup pump will destroy the pump within approximately: (1.0)

a. 3 seconds

b. 15 seconds

c. 1 minute

d. 3 minutes

4.18 Which of the following choices are the correct fillins for these statements? (1.0)

"The maximum weekly exposure is __(1)__. A/The __(2)__ may authorize exposures to __(3)__ by use of Form 912801, Authorization to Exceed Radiation Exposure Limits."

a. (1) 600 mrem
(2) Nuclear Plant Manager
(3) 1250 mrem

b. (1) 300 mrem
(2) Nuclear Plant Manager
(3) 1250 mrem

c. (1) 300 mrem
(2) ChemRad Supervisor
(3) 600 mrem

d. (1) 600 mrem
(2) ChemRad Supervisor
(3) 2 Rem

4.19 Which of the following statements is CORRECT concerning RWP's and SRWP's? (1.0)

a. SRWP's are generally required for non-routine work.

b. For emergency, short-term or special situations, the continuous presence of a qualified ChemRad representative may meet the RWP requirement.

c. SRWPs may be issued when periodic radiation surveys show that individuals will not encounter a dose rate in excess of 100 mrem/hr.

d. The RWP will list all equipment allowed to be taken into and removed from a designated area.

4.20 Select the CORRECT statement concerning entrance into a Contaminated Area. (1.0)

a. Only rubber gloves are allowed in contaminated areas.

b. Rubber or plastic gloves used in wet contaminated areas should be taped to the inside of a plastic suit, if one is being worn.

c. Personnel dosimetry and identification badges should be worn inside protective clothing such that they will not fall off and/or become contaminated.

d. In cases of routine or special maintenance that involves high contamination levels, a plastic suit will be required.

4.21 List your Immediate Actions for AP-990, "Shutdown From Outside Control Room" (1.5)

4.22 TRUE or FALSE (0.5)

The first Immediate Action of AP-580, RPS Actuation, is to ensure group 1-7 rods are inserted. The Remedial Action for this step directs you to EP-140, Emergency Reactivity Control.

END OF SECTION 4

END OF EXAM

$E = mc^2$

$KE = 1/2\ mv^2$

$PE = mgh$

$V_f = V_o + at$

$W = v\ \Delta P$

$\Delta E = 931\ \Delta m$

$\dot{Q} = \dot{m}\Delta h$

$\dot{Q} = \dot{m}C_p\Delta t$

$\dot{Q} = UA\Delta T$

$Pwr = W_f\Delta h$

$P = P_0 10^{sur(t)}$

$P = P_0 e^{t/T}$

$SUR = 26.06/T$

$SUR = 26\rho/\ell^* + (\beta - \rho)T$

$T = (\ell^*/\rho) + [(\beta - \rho)/\bar{\lambda}\rho]$

$T = \ell/(\rho - \beta)$

$T = (\beta - \rho)/(\bar{\lambda}\rho)$

$\rho = (K_{eff}-1)/K_{eff} = \Delta K_{eff}/K_{eff}$

$\rho = [(\ell^*/(T K_{eff})] + [\bar{\beta}_{eff}/(1 + \bar{\lambda}T)]$

$P = (\Sigma\phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

$s = (V_f - V_o)/t$

$a = (V_f - V_o)/t$

$A = \frac{\pi D^2}{4}$

$\dot{m} = V_{av}A_\rho$

$A = \lambda N \qquad A = A_o e^{-\lambda t}$

$\lambda = \ln 2/t_{1/2} = 0.693/t_{1/2}$

$t_{1/2}^{eff} = \frac{[(t_{1/2})(t_b)]}{[(t_{1/2}) + (t_b)]}$

$I = I_o e^{-\Sigma x}$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

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

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$M = 1/(1 - K_{eff}) = CR_1/CR_o$

$M = (1 - K_{effo})/(1 - K_{eff1})$

$SDM = (1 - K_{eff})/K_{eff}$

$\ell^* = 10^{-4}$ seconds

$\bar{\lambda} = 0.1$ seconds^{-1}

$I_1 d_1 = I_2 d_2$

$I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$

$R/hr = (0.5\ CE)/d^2$(meters)

$R/hr = 6\ CE/d^2$ (feet)

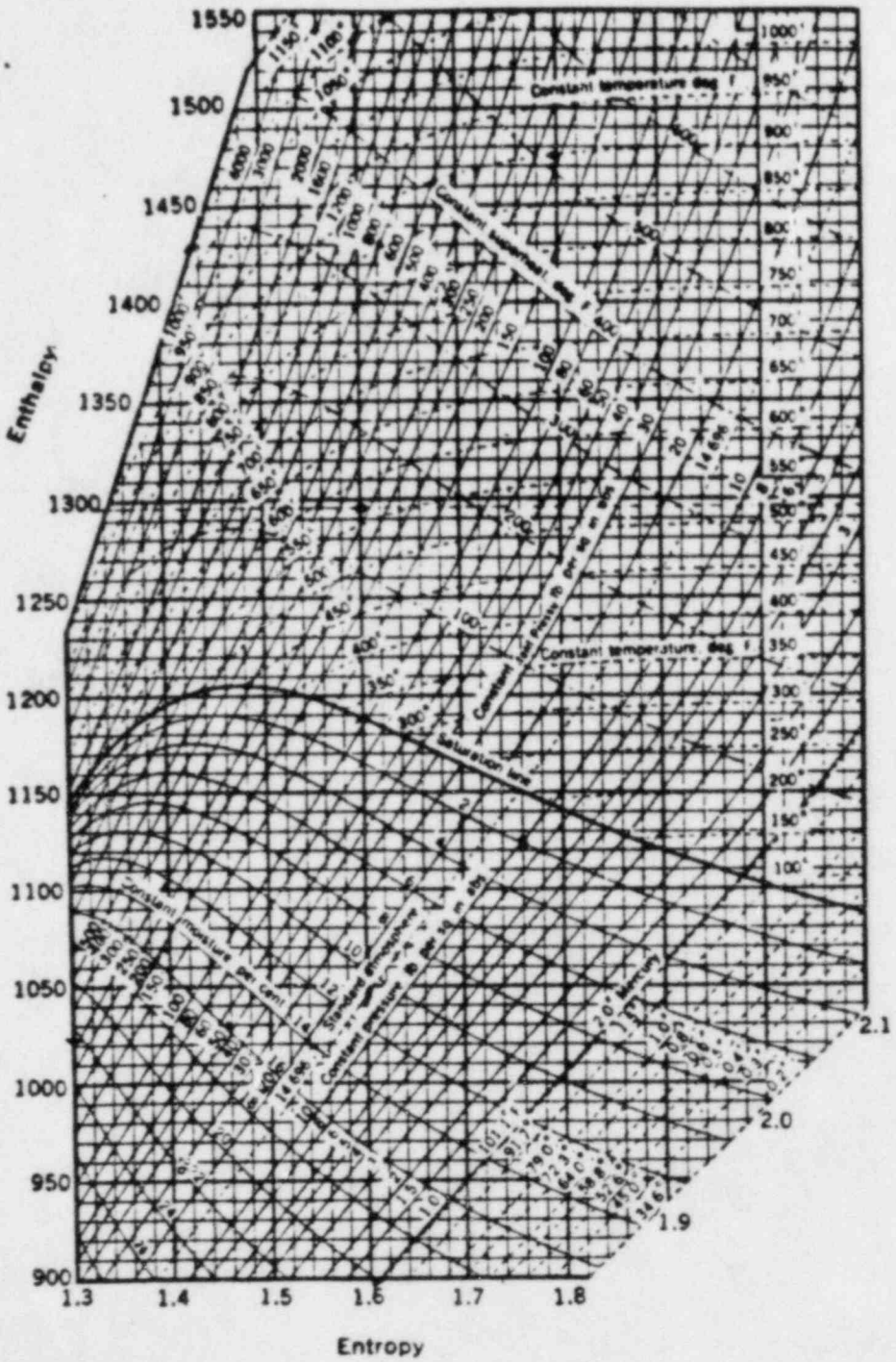
Water Parameters

1 gal. = 8.345 lbm.
1 gal. = 3.78 liters
1 ft^3 = 7.48 gal.
Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3
Heat of vaporization = 970 Btu/lbm
Heat of fusion = 144 Btu/lbm
1 Atm = 14.7 psi = 29.9 in. Hg.
1 ft. H_2O = 0.4335 lbf/in.

Miscellaneous Conversions

1 curie = 3.7×10^{10} dps
1 kg = 2.21 lbm
1 hp = 2.54×10^3 Btu/hr
1 mw = 3.41×10^6 Btu/hr
1 in = 2.54 cm
°F = 9/5°C + 32
°C = 5/9 (°F-32)
1 BTU = 778 ft-lbf

e = 2.718



Mollier diagram for steam

TABLE D-1.2*
Properties of Dry Saturated Steam • Pressure

Abs press., psia	Temp. °F	Specific volume		Enthalpy			Entropy		
		Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor	Sat liquid	Evap	Sat vapor
p	t	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
1.0	101.74	0.01614	333.6	69.70	1036.3	1106.0	0.1326	1.8456	1.9782
2.0	126.08	0.01623	173.73	93.99	1022.2	1116.2	0.1749	1.7451	1.9200
3.0	141.48	0.01630	118.71	109.37	1013.2	1122.6	0.2008	1.6855	1.8863
4.0	152.97	0.01636	90.63	120.86	1006.4	1127.3	0.2198	1.6427	1.8625
5.0	162.24	0.01640	73.52	130.13	1001.0	1131.1	0.2347	2.6094	1.8441
6.0	170.06	0.01645	61.98	137.96	996.2	1134.2	0.2472	1.5820	1.8292
7.0	176.85	0.01649	53.64	144.76	992.1	1136.9	0.2581	1.5586	1.8167
8.0	182.86	0.01653	47.34	150.79	988.5	1139.3	0.2674	1.5383	1.8057
9.0	188.28	0.01656	42.40	156.22	985.2	1141.4	0.2759	1.5203	1.7962
10	193.21	0.01659	38.42	161.17	982.1	1143.3	0.2835	1.5041	1.7876
14.696	212.00	0.01672	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566
15	213.03	0.01672	26.29	181.11	969.7	1150.8	0.3135	1.4415	1.7549
20	227.96	0.01683	20.089	196.16	960.1	1156.3	0.3356	1.3962	1.7319
25	240.07	0.01692	16.303	208.42	952.1	1160.6	0.3533	1.3606	1.7139
30	250.33	0.01701	13.746	218.82	945.3	1164.1	0.3680	1.3313	1.6993
35	259.28	0.01708	11.898	227.91	939.2	1167.1	0.3807	1.3063	1.6870
40	267.25	0.01715	10.498	236.03	933.7	1169.7	0.3919	1.2844	1.6763
45	274.44	0.01721	9.401	243.36	928.6	1172.0	0.4019	1.2650	1.6669
50	281.01	0.01727	8.515	250.09	924.0	1174.1	0.4110	1.2474	1.6585
55	287.07	0.01732	7.787	256.30	919.6	1175.9	0.4193	1.2316	1.6509
60	292.71	0.01738	7.175	262.09	915.5	1177.6	0.4270	1.2168	1.6438
65	297.97	0.01743	6.655	267.50	911.6	1179.1	0.4342	1.2032	1.6374
70	302.92	0.01748	6.206	272.61	907.9	1180.6	0.4409	1.1906	1.6315
75	307.60	0.01753	5.816	277.43	904.5	1181.9	0.4472	1.1787	1.6259
80	312.03	0.01757	5.472	282.02	901.1	1183.1	0.4531	1.1676	1.6207
85	316.25	0.01761	5.168	286.39	897.8	1184.2	0.4587	1.1571	1.6158
90	320.27	0.01766	4.896	290.56	894.7	1185.3	0.4641	1.1471	1.6112
95	324.12	0.01770	4.652	294.56	891.7	1186.2	0.4692	1.1376	1.6068
100	327.81	0.01774	4.432	298.40	888.8	1187.2	0.4740	1.1286	1.6026
110	334.77	0.01782	4.049	305.66	883.2	1188.9	0.4832	1.1117	1.5948

TABLE D-1a
Properties of Dry Saturated Steam *(continued)*
Pressure

Abs press., psia	Temp., °F	Specific volume		Enthalpy			Entropy		
		Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor	Sat liquid	Evap	Sat vapor
p	t	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
120	341.25	0.01789	3.728	312.44	877.9	1190.4	0.4916	1.0962	1.5878
130	347.32	0.01796	3.455	318.81	872.9	1191.7	0.4995	1.0817	1.5812
140	353.02	0.01802	3.220	324.82	868.2	1193.0	0.5069	1.0682	1.5751
150	358.42	0.01809	3.015	330.51	863.6	1194.1	0.5138	1.0556	1.5694
160	363.53	0.01815	2.834	335.93	859.2	1195.1	0.5204	1.0436	1.5640
170	368.41	0.01822	2.675	341.09	854.9	1196.0	0.5266	1.0324	1.5590
180	373.06	0.01827	2.532	346.03	850.8	1196.9	0.5325	1.0217	1.5542
190	377.51	0.01833	2.404	350.79	846.8	1197.6	0.5381	1.0116	1.5497
200	381.79	0.01839	2.288	355.36	843.0	1198.4	0.5435	1.0018	1.5453
250	400.95	0.01865	1.8438	376.00	825.1	1201.1	0.5675	0.9588	1.5263
300	417.33	0.01890	1.5433	393.84	809.0	1202.8	0.5879	0.9225	1.5104
350	431.72	0.01913	1.3260	409.69	794.2	1203.9	0.6056	0.8910	1.4966
400	444.59	0.0193	1.1613	424.0	780.5	1204.5	0.6214	0.8630	1.4844
450	456.28	0.0195	1.0320	437.2	767.4	1204.6	0.6356	0.8378	1.4734
500	467.01	0.0197	0.9278	449.4	755.0	1204.4	0.6487	0.8147	1.4634
550	476.94	0.0199	0.8424	460.8	743.1	1203.9	0.6608	0.7934	1.4542
600	486.21	0.0201	0.7698	471.6	731.6	1203.2	0.6720	0.7734	1.4454
650	494.90	0.0203	0.7083	481.8	720.5	1202.3	0.6826	0.7548	1.4374
700	503.10	0.0205	0.6554	491.5	709.7	1201.2	0.6925	0.7371	1.4296
750	510.86	0.0207	0.6092	500.8	699.2	1200.0	0.7019	0.7204	1.4223
800	518.23	0.0209	0.5687	509.7	688.9	1198.6	0.7108	0.7045	1.4153
850	525.26	0.0210	0.5327	518.3	678.8	1197.1	0.7194	0.6891	1.4085
900	531.98	0.0212	0.5006	526.6	668.8	1195.4	0.7275	0.6744	1.4020
950	538.43	0.0214	0.4717	534.6	659.1	1193.7	0.7355	0.6602	1.3957
1000	544.61	0.0216	0.4456	542.4	649.4	1191.8	0.7430	0.6467	1.3897
1100	556.31	0.0220	0.4001	557.4	630.4	1187.7	0.7575	0.6205	1.3780
1200	567.22	0.0223	0.3619	571.7	611.7	1183.4	0.7711	0.5956	1.3667
1300	577.46	0.0227	0.3293	585.4	593.2	1178.6	0.7840	0.5719	1.3559
1400	587.10	0.0231	0.3012	598.7	574.7	1173.4	0.7963	0.5491	1.3454
1500	596.23	0.0235	0.2765	611.6	556.3	1167.9	0.8082	0.5269	1.3351
2000	635.82	0.0257	0.1878	671.7	463.4	1135.1	0.8619	0.4230	1.2849
2500	668.13	0.0287	0.1307	730.6	360.5	1091.1	0.9126	0.3197	1.2322
3000	695.36	0.0346	0.0858	802.5	217.8	1020.3	0.9731	0.1885	1.1615
3206.2	705.40	0.0503	0.0503	902.7	0	902.7	1.0580	0	1.0580

TABLE D-1b
Properties of Dry Saturated Steam *(continued)*
Temperature

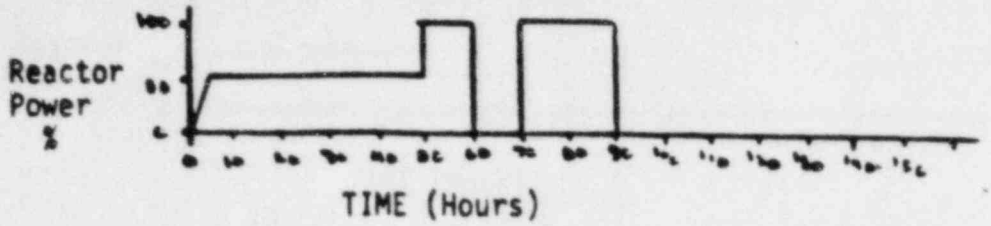
Temp., °F	Abs press., psia	Specific volume		Enthalpy			Entropy		
		Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor	Sat liquid	Evap	Sat vapor
t	p	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
32	0.08854	0.01602	330[illegible]	0.00	1075.8	1075.8	0.0000	2.1877	2.1877
35	0.09995	0.01602	2947	3.02	1074.1	1077.1	0.0061	2.1709	2.1770
40	0.12170	0.01602	2444	8.05	1071.3	1079.3	0.0162	2.1435	2.1597
45	0.14752	0.01602	2036.4	13.06	1068.4	1081.5	0.0262	2.1167	2.1429
50	0.17811	0.01603	1703.2	18.07	1065.6	1083.7	0.0361	2.0903	2.1264
60	0.2563	0.01604	1206.7	28.06	1059.9	1088.0	0.0555	2.0393	2.0948
70	0.3631	0.01606	867.9	38.04	1054.3	1092.3	0.0745	1.9902	2.0647
80	0.5069	0.01608	633.1	48.02	1048.6	1096.6	0.0932	1.9428	2.0360
90	0.6982	0.01610	468.0	57.99	1042.9	1100.9	0.1115	1.8972	2.0087
100	0.9492	0.01613	350.4	67.97	1037.2	1105.2	0.1295	1.8531	1.9826
110	1.2748	0.01617	265.4	77.94	1031.6	1109.5	0.1417	1.8106	1.9577
120	1.6924	0.01620	203.27	87.92	1025.8	1113.7	0.1645	1.7694	1.9339
130	2.2225	0.01625	157.34	97.90	1020.0	1117.9	0.1816	1.7296	1.9112
140	2.8886	0.01629	123.01	107.89	1014.1	1122.0	0.1984	1.6910	1.8894
150	3.718	0.01634	97.07	117.89	1008.2	1126.1	0.2149	1.6537	1.8685
160	4.741	0.01639	77.29	127.89	1002.3	1130.2	0.2311	1.6174	1.8485
170	5.992	0.01645	62.06	137.90	996.3	1134.2	0.2472	1.5822	1.8293
180	7.510	0.01651	50.23	147.92	990.2	1138.1	0.2630	1.5480	1.8109
190	9.339	0.01657	40.96	157.95	984.1	1142.0	0.2785	1.5147	1.7932
200	11.526	0.01663	33.64	167.99	977.9	1145.9	0.2938	1.4824	1.7762
210	14.123	0.01670	27.82	178.05	971.6	1149.7	0.3090	1.4508	1.7598
212	14.696	0.01672	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566
220	17.186	0.01677	23.15	188.13	965.2	1153.4	0.3239	1.4201	1.7440
230	20.780	0.01684	19.382	198.23	958.8	1157.0	0.3387	1.3901	1.7288
240	24.969	0.01692	16.323	208.34	952.2	1160.5	0.3531	1.3609	1.7140
250	29.825	0.01700	13.821	216.48	945.5	1164.0	0.3675	1.3323	1.6998
260	35.429	0.01709	11.763	228.64	938.7	1167.3	0.3817	1.3043	1.6860
270	41.858	0.01717	10.061	238.84	931.8	1170.6	0.3958	1.2769	1.6727
280	49.203	0.01726	8.645	249.06	924.7	1173.8	0.4096	1.2501	1.6597
290	57.556	0.01735	7.461	259.31	917.5	1176.8	0.4234	1.2238	1.6472
300	67.013	0.01745	6.466	269.59	910.1	1179.7	0.4369	1.1980	1.6350
310	77.68	0.01755	5.626	279.92	902.6	1182.5	0.4504	1.1727	1.6231
320	89.66	0.01765	4.914	290.28	894.9	1185.2	0.4637	1.1478	1.6115
330	103.06	0.01776	4.307	300.68	887.0	1187.7	0.4769	1.1233	1.6002
340	118.01	0.01787	3.788	311.13	879.0	1190.1	0.4900	1.0992	1.5891

TABLE D-1b
Properties of Dry Saturated Steam *(continued)*
Temperature

Temp. °F	Abs. press. psia	Specific volume		Enthalpy			Entropy		
		Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor	Sat liquid	Evap	Sat vapor
t	p	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
350	134.63	0.01799	3.342	321.63	870.7	1192.3	0.5029	1.0754	1.5783
360	153.04	0.01811	2.957	332.18	852.2	1194.4	0.5158	1.0519	1.5677
370	173.37	0.01823	2.625	342.79	853.5	1196.3	0.5286	1.0287	1.5573
380	195.77	0.01836	2.335	353.45	844.6	1198.1	0.5413	1.0059	1.5471
390	220.37	0.01850	2.0836	364.17	835.4	1199.6	0.5539	0.9832	1.5371
400	247.31	0.01864	1.8633	374.97	826.0	1201.0	0.5664	0.9608	1.5272
410	276.75	0.01878	1.6700	385.83	816.3	1202.1	0.5788	0.9386	1.5174
420	308.83	0.01894	1.5000	396.77	806.3	1203.1	0.5912	0.9166	1.5078
430	343.72	0.01910	1.3499	407.79	796.0	1203.8	0.6035	0.8947	1.4982
440	381.59	0.01926	1.2171	418.90	785.4	1204.3	0.6158	0.8730	1.4887
450	422.6	0.0194	1.0993	430.1	774.5	1204.6	0.6280	0.8513	1.4793
460	466.9	0.0196	0.9944	441.4	763.2	1204.6	0.6402	0.8298	1.4700
470	514.7	0.0198	0.9009	452.8	751.5	1204.3	0.6523	0.8083	1.4606
480	566.1	0.0200	0.8172	464.4	739.4	1203.7	0.6645	0.7868	1.4513
490	621.4	0.0202	0.7423	476.0	726.8	1202.8	0.6766	0.7653	1.4419
500	680.8	0.0204	0.6749	487.8	713.9	1201.7	0.6887	0.7438	1.4325
520	812.4	0.0209	0.5594	511.9	686.4	1198.2	0.7130	0.7006	1.4136
540	962.5	0.0215	0.4649	536.6	656.6	1193.2	0.7374	0.6568	1.3942
560	1133.1	0.0221	0.3868	562.2	624.2	1186.4	0.7621	0.6121	1.3742
580	1325.8	0.0228	0.3217	588.9	588.4	1177.3	0.7872	0.5659	1.3532
600	1542.9	0.0236	0.2668	610.0	548.5	1165.5	0.8131	0.5176	1.3307
620	1786.6	0.0247	0.2201	646.7	503.6	1150.3	0.8398	0.4664	1.3062
640	2059.7	0.0260	0.1798	678.6	452.0	1130.5	0.8679	0.4110	1.2789
660	2365.4	0.0278	0.1442	714.2	390.2	1104.4	0.8987	0.3485	1.2472
680	2708.1	0.0305	0.1115	757.3	309.9	1067.2	0.9351	0.2719	1.2071
700	3093.7	0.0369	0.0761	823.3	172.1	995.4	0.9905	0.1484	1.1389
705.4	3206.2	0.0503	0.0503	902.7	0	902.7	1.0580	0	1.0580

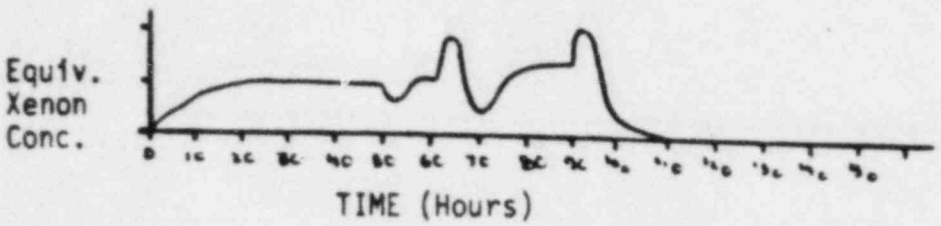
Abs. pres., psia (Sat. temp., °F)		Temperature, °F											
		200	300	400	500	600	700	800	900	1000	1100	1200	1400
	v	392.6	452.3	512.0	571.6	631.2	690.8	750.4	809.9	869.5	929.1	988.7	1107.8
1	h	1150.4	1195.8	1241.7	1288.3	1335.7	1383.8	1432.8	1482.7	1533.5	1585.2	1637.7	1745.7
(101.74)	s	2.0512	2.1153	2.1720	2.2233	2.2702	2.3137	2.3542	2.3923	2.4283	2.4625	2.4952	2.5566
	v	78.16	90.25	102.26	114.22	126.16	138.10	150.03	161.95	173.87	185.79	197.71	221.6
5	h	1148.8	1195.0	1241.2	1288.0	1335.4	1383.6	1432.7	1482.6	1533.4	1585.1	1637.7	1745.7
(162.24)	s	1.8718	1.9370	1.9942	2.0456	2.0927	2.1361	2.1767	2.2148	2.2509	2.2851	2.3178	2.3792
	v	38.85	45.00	51.04	57.05	63.03	69.01	74.98	80.95	86.92	92.88	98.84	110.77
10	h	1146.6	1193.9	1240.6	1287.5	1335.1	1383.4	1432.5	1482.4	1533.2	1585.0	1637.6	1745.6
(193.21)	s	1.7927	1.8595	1.9172	1.9689	2.0160	2.0596	2.1002	2.1383	2.1744	2.2068	2.2413	2.3028
	v	.....	30.53	34.68	38.78	42.86	46.94	51.00	55.07	59.13	63.19	67.25	75.37
14.696	h	.....	1192.8	1239.9	1287.1	1334.8	1383.2	1432.3	1482.3	1533.1	1584.8	1637.5	1745.5
(212.00)	s	.....	1.8160	1.8743	1.9261	1.9734	2.0170	2.0576	2.0958	2.1319	2.1662	2.1989	2.2603
	v	.....	22.36	25.43	28.46	31.47	34.47	37.46	40.45	43.44	46.42	49.41	55.37
20	h	.....	1191.6	1239.2	1286.6	1334.4	1382.9	1432.1	1482.1	1533.0	1584.7	1637.4	1745.4
(227.96)	s	.....	1.7808	1.8396	1.8918	1.9392	1.9829	2.0235	2.0618	2.0978	2.1321	2.1648	2.2263
	v	.....	11.040	12.628	14.168	15.688	17.198	18.702	20.20	21.70	23.20	24.69	27.68
40	h	.....	1186.8	1236.5	1284.8	1333.1	1381.9	1431.3	1481.4	1532.4	1584.3	1637.0	1745.1
(267.25)	s	.....	1.6994	1.7608	1.8140	1.8619	1.9058	1.9467	1.9850	2.0212	2.0555	2.0883	2.1498
	v	.....	7.259	8.357	9.403	10.427	11.441	12.449	13.452	14.454	15.453	16.451	18.446
60	h	.....	1181.6	1233.6	1283.0	1331.8	1380.9	1430.5	1480.8	1531.9	1583.8	1636.6	1744.8
(292.71)	s	.....	1.6492	1.7135	1.7678	1.8162	1.8605	1.9015	1.9400	1.9762	2.0106	2.0434	2.1049
	v	.....	.....	6.220	7.020	7.797	8.562	9.322	10.077	10.830	11.582	12.332	13.830
80	h	.....	.....	1230.7	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3	1583.4	1636.2	1744.5
(312.03)	s	.....	.....	1.6791	1.7346	1.7836	1.8281	1.8694	1.9079	1.9442	1.9787	2.0115	2.0731
	v	.....	.....	4.937	5.589	6.218	6.835	7.446	8.052	8.656	9.259	9.860	11.060
100	h	.....	.....	1227.6	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8	1582.9	1635.7	1744.2
(327.81)	s	.....	.....	1.6518	1.7085	1.7581	1.8029	1.8443	1.8829	1.9193	1.9538	1.9867	2.0484
	v	.....	.....	4.081	4.636	5.165	5.683	5.195	6.702	7.207	7.710	8.212	9.214
120	h	.....	.....	1224.4	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2	1582.4	1635.3	1743.9
(341.25)	s	.....	.....	1.6287	1.6869	1.7370	1.7822	1.8237	2.8625	1.8990	1.9335	1.9664	2.0281
	v	.....	.....	3.468	3.954	4.413	4.861	5.301	5.738	6.172	6.604	7.035	7.895
140	h	.....	.....	1221.1	1275.2	1326.4	1376.8	1427.3	1478.2	1529.7	1581.9	1634.9	1743.5
(353.02)	s	.....	.....	1.6087	1.6683	1.7190	1.7645	1.8063	1.8451	1.8817	1.9163	1.9493	2.0110
	v	.....	.....	3.008	3.443	3.849	4.244	4.631	5.015	5.396	5.775	6.152	6.906
160	h	.....	.....	1217.6	1273.1	1325.0	1375.7	1426.4	1477.5	1529.1	1581.4	1634.5	1743.2
(363.53)	s	.....	.....	1.5908	1.6519	1.7033	1.7491	1.7911	1.8301	1.8667	1.9014	1.9344	1.9962
	v	.....	.....	2.649	3.044	3.411	3.764	4.110	4.452	4.792	5.129	5.466	6.136
180	h	.....	.....	1214.0	1271.0	1323.5	1374.7	1425.6	1476.8	1528.6	1581.0	1634.1	1742.9
(373.06)	s	.....	.....	1.5745	1.6373	1.6894	1.7355	1.7776	1.8167	1.8534	1.8882	1.9212	1.9831
	v	.....	.....	2.361	2.726	3.060	3.380	3.693	4.002	4.309	4.613	4.917	5.521
200	h	.....	.....	1210.3	1268.9	1322.1	1373.6	1424.8	1476.2	1528.0	1580.5	1633.7	1742.6
(381.79)	s	.....	.....	1.5594	1.6240	1.6767	1.7232	1.7655	1.8048	1.8415	1.8763	1.9094	1.9713
	v	.....	.....	2.125	2.465	2.772	3.066	3.352	3.634	3.913	4.191	4.467	5.017
220	h	.....	.....	1206.5	1266.7	1320.7	1372.6	1424.0	1475.5	1527.5	1580.0	1633.3	1742.3
(389.86)	s	.....	.....	1.5453	1.6117	1.6652	1.7120	1.7545	1.7939	1.8308	1.8656	1.8987	1.9607
	v	.....	.....	1.9276	2.247	2.533	2.804	3.068	3.327	3.584	3.839	4.093	4.597
240	h	.....	.....	1202.5	1264.5	1319.2	1371.5	1423.2	1474.8	1526.9	1579.6	1632.9	1742.0
(397.37)	s	.....	.....	1.5319	1.6003	1.6546	1.7017	1.7444	1.7839	1.8209	1.8558	1.8889	1.9510
	v	.....	.....	.....	2.063	2.330	2.582	2.827	3.067	3.305	3.541	3.776	4.242
260	h	.....	.....	.....	1262.3	1317.7	1370.4	1422.3	1474.2	1526.3	1579.1	1632.5	1741.7
(404.42)	s	.....	.....	.....	1.5897	1.6447	1.6922	1.7352	1.7748	1.8118	1.8467	1.8799	1.9420
	v	.....	.....	.....	1.9047	2.156	2.392	2.621	2.845	3.066	3.286	3.504	3.938
280	h	.....	.....	.....	1260.0	1316.2	1369.4	1421.5	1473.5	1525.8	1578.6	1632.1	1741.4
(411.05)	s	.....	.....	.....	1.5796	1.6354	1.6834	1.7265	1.7662	1.8033	1.8383	1.8716	1.9337
	v	.....	.....	.....	1.7675	2.005	2.227	2.442	2.652	2.859	3.065	3.269	3.674
300	h	.....	.....	.....	1260.0	1316.2	1368.3	1420.6	1472.8	1525.2	1578.1	1631.7	1741.0
(417.33)	s	.....	.....	.....	1.5701	1.6268	1.6751	1.7184	1.7582	1.7954	1.8305	1.8638	1.9260
	v	.....	.....	.....	1.4923	1.7036	1.8980	2.084	2.266	2.445	2.622	2.798	3.147
350	h	.....	.....	.....	1251.5	1310.9	1365.5	1418.5	1471.1	1523.8	1577.0	1630.7	1740.3
(431.72)	s	.....	.....	.....	1.5481	1.6070	1.6563	1.7002	1.7403	1.7777	1.8130	1.8463	1.9086
	v	.....	.....	.....	1.2851	1.4770	1.6508	1.8161	1.9767	2.134	2.290	2.445	2.751
400	h	.....	.....	.....	1245.1	1306.9	1362.7	1416.4	1469.4	1522.4	1575.8	1629.6	1739.5
(444.59)	s	.....	.....	.....	1.5281	1.5894	1.6398	1.6842	1.7247	1.7623	1.7977	1.8311	1.8938

Power History:



XENON transients

1.



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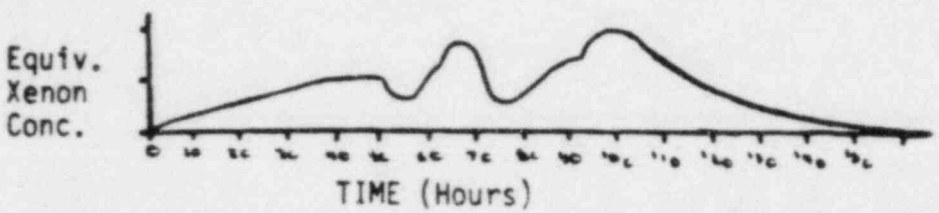

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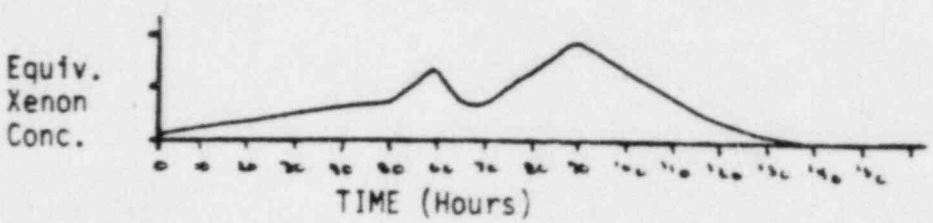

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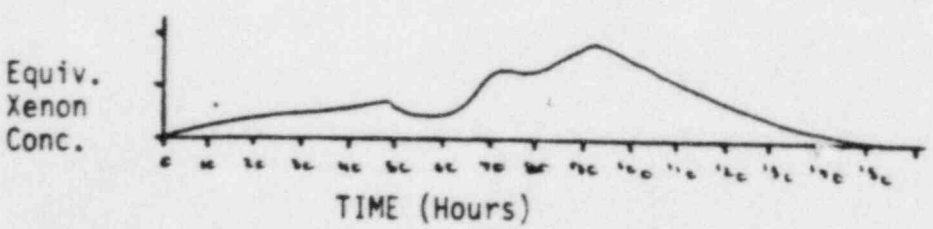


-WORKSHEET II-

ESTIMATED CRITICAL BORON CONCENTRATION

REFERENCE CONDITIONS: 532°F, 0% FP, No Xenon, No Control Rods, Equilibrium Samarium

1. Fuel Reactivity

a. Core Burnup 200 EFPD
b. Read Curve 3.1 of OP-103, Plant Curve Book. (A) _____ % Δk/k

2. Xenon Reactivity (Use Step 2.1 or 2.2)

2.1 Value calculated by SAXON I (submit printout). (_____ % Δk/k) = (B) _____ % Δk/k

OR

2.2 a. Last power level was 100 % FP for 504 hrs.
b. Time Shutdown _____ hrs.
c. If time at last power level was < 40 hrs. and SAXON is unavailable, consult with Reactor Specialist. (_____ % Δk/k) = _____ % Δk/k

3. Samarium Reactivity Buildup After Shutdown

3.1 Value calculated by SAXON I (submit printout) _____ % Δk/k

4. Reactivity Effect From Temperature

a. Average RC Temperature 525 °F
b. Reference temperature is 532°F.
c. Temperature coefficient at _____ ppmB is obtained from Curve 3.6 of OP-103, Plant Curve Book, to be _____ x 10^{-2}% Δk/k/°F.
d. Reactivity = [T(ave) - 532] [Temp. Coeff.]
e. Reactivity = (_____ - _____) (_____ x 10^{-2}% Δk/k/°F) = (C) _____ % Δk/k

5. Reactivity of Control Rods at Desired Insertion

Groups 1-4 at	100 % WD		
Group 5 at	100 % WD		
Group 6 at	100 % WD		
Group 7 at	80 % WD	Regulating Group Worth	(D) _____ % Δk/k
Group 8 at	40 % WD	Group 8 Worth	_____ % Δk/k

Calculated By _____ Date _____

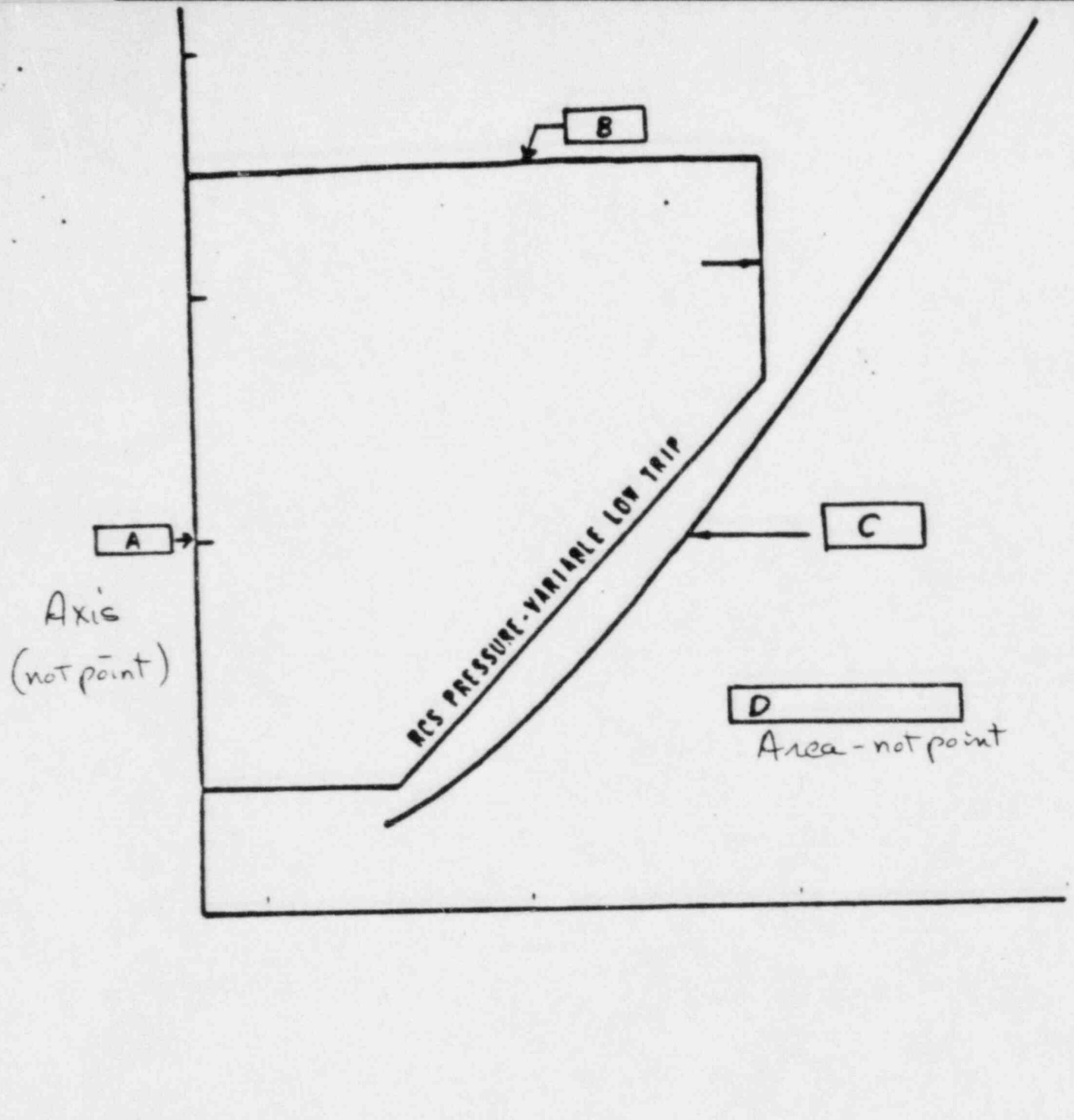


FIGURE 1

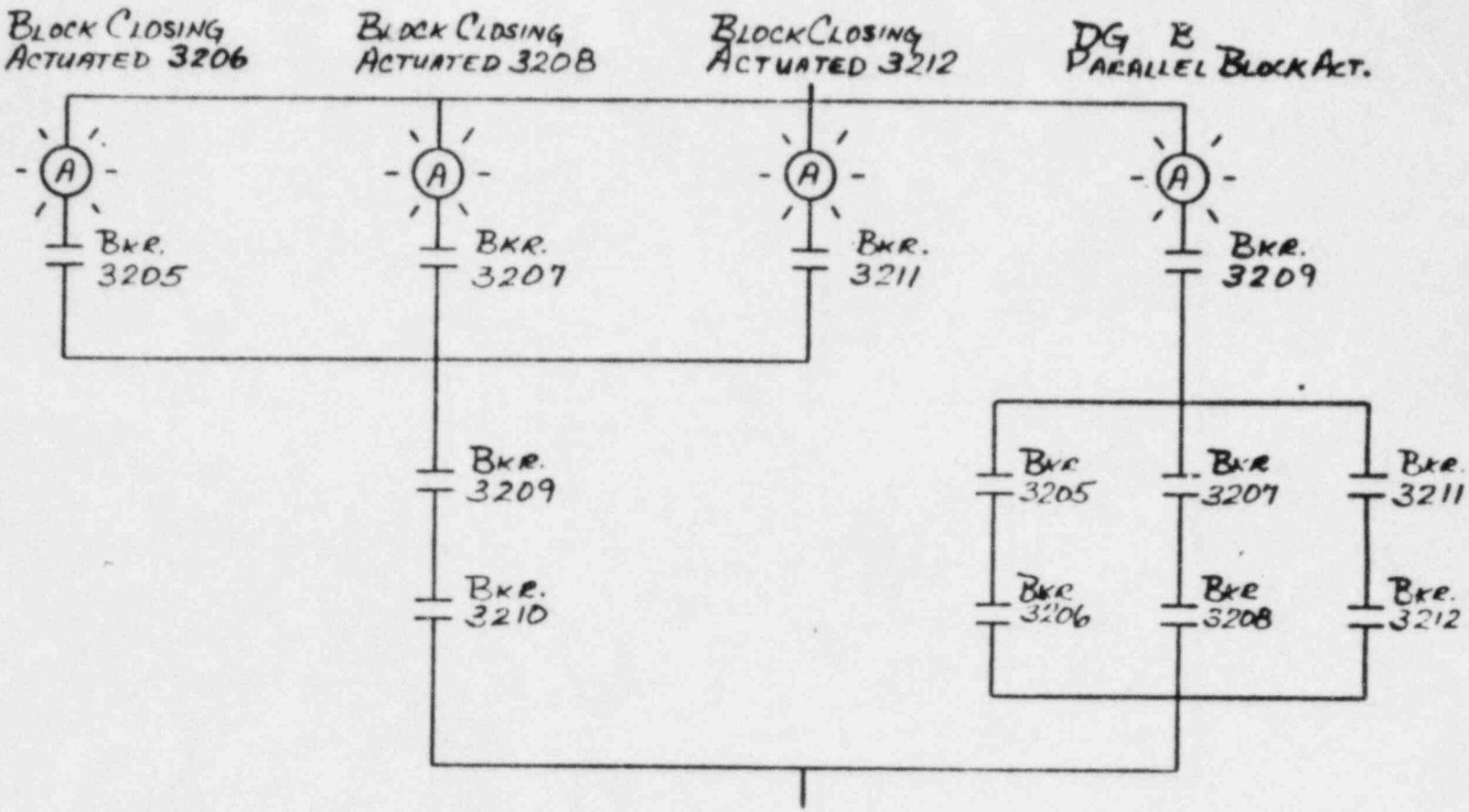
REACTOR CORE SAFETY LIMIT

480V. ES MCC (3A-1)

250/125 V. DC BUS (3A)

120V A.C. VITAL BUS (3A)

FIGURE 2.19


BLOCK CLOSING ACTUATED 3206
BLOCK CLOSING ACTUATED 3208
BLOCK CLOSING ACTUATED 3212
DG B PARALLEL BLOCK ACT.
A
BKR. 3205
BKR. 3207
BKR. 3211
BKR. 3209
BKR. 3209
BKR. 3210
BKR 3205
BKR 3207
BKR. 3211
BKR 3206
BKR 3208
BKR. 3212

ANSWERS 1.0 (25.0)

1.1 (b) (1.0)

Reference: NUS, NETRO, 10.2-2.

1.2 (b) (1.0)

Reference: NUS, NETRO, p. 11.4-3.

1.3 (c) (1.0)

Reference: NUS, NETRO, p 1.4-1

1.4 (d) (1.0)

Reference: GP, HTT of FFF, B3.3 p. 355

1.5 (b) (1.0)

Reference: STM-504

1.6 (c) (1.0)

Ref: NUS, NETRO Unit 12

1.7 (b) (1.0)

Reference: 1. NUS, NETRO, Unit 6
2. Westinghouse Reactor Physics, Sect. 3, Neutron Kinetics and Sect. 5, Core Physics.

1.8 (c) (1.0)

Reference: NUS, NETRO, 10.3

1.9 (d) (1.0)

Ref: NUS - Plant Performance - pp 6.2-5 and 6.4 - 5

1.10 (d) (1.0)

Ref: NUS Plant Performance pp 6.4-5+6

1.11 (d) (1.0)

Ref: NUS Plant Performance, pp 3.3-2

1.12 (c) (1.0)

Reference: Steam Tables or Mollier Diagram.

1.13 (b) (1.0)

Reference: 1. Westinghouse NTO, pg I-5.77
2. NUS, NETRO, 10.5-2

1.14 (b) (1.0)

Reference: 1. Duke Power Co. FNRE
2. NUS, NETRO, 10.4-2

1.15 (c) (1.0)

Reference: 1. STM-6-19
2. NUS, NETRO, Section 6.3

1.16 (d) (1.0)

Reference: OP-210, p. 18

1.17 (c) (1.0)

Reference: 1. GP, HTT & FFF, II B2, p. 182
2. CR, HTT, Section 1 p. 71, 157

1.18 (b) (1.0)

Reference: T.S. pp B3/4 1-1

1.19 (d) (1.0)

Reference: T.S. pp 3/4 2-12

1.20 (a) (1.0)

Reference: OP-103 curves 4.7A, B, 4.8, 3.8A, B, C, D, 3.15A, 3.17 and STS 3/4 1-1.

1.21 (b) (1.0)

Reference: NUS Plant Performance, pp 6.5-1 to 6.5-3

~~1.22 a. FALSE~~ delete ~~(0.5)~~

b. FALSE (0.5)

Reference: a. CR3 HTFF/Thermo, last page
b. AP-460 and AP-380

1.23 A - Core Outlet Pressure, psig or RCS pressure (2.0)
B - RCS - Pressure High Trip
C - Safety Limit or minimum DNBR limit (1.30)
D - Unacceptable Operation

Reference: T. S. Safety Limit Curve, pg 2-2

1.24 Answer: Zr - H2O Reaction (1.0)
Dissolved H2 in RCS
Radiolytic decomposition of Water any 2
Aluminum - NaOH reaction (.5 ea)

Reference: CR3 Draft HTFF/Thermo, Section 4, Post-LOCA H2 Sources.

ANSWERS 2.0 (25.0)

2.1 (1.0)
Answer: (d)

Reference: RB Isolation and Cooling System Lesson Plan, ANO-91

2.2 (1.0)
Answer: (b)

Reference: STM-25-21, 22, 23, 24, and 25.
AP-1071, p. 1.

2.3 (1.0)

Answer: (a)

Reference: AP-304, p. 4

2.4 (1.0)

Answer: (d) - Selector switch is located at GW pumps
Also (b) -
Reference: STM-25-14
Ref: for (b) - NAO-91

2.5 (1.0)

Answer: (c)

Reference: STM 2-105, 106, 67, 106.
OP-302. REV.22, pg 2.

2.6 (1.0)

Answer: (d)

Reference: STM 2-34, 27, 54 and 16

2.7 (1.0)

Answer: (a)

Reference: OP-404, p. 32

2.8 (1.0)

Answer: (b)

Reference: OP-401, p. 7 and 8

2.9 (1.0)

Answer: (d)

Reference: STM 12-4, 10, 9 and 4.

2.10 (1.0)

Answer: (a)

Reference: STM-28-5.

2.11 (1.0)

Answer (a) Also (d)

Reference: STM-405
BW ~~NRC~~ ANO-91, Pg 15
(b) - (BSV-16 & 17 are normally open)
(c) - (Valves open on 4 psig, pumps start on 30 psig)
(d) - (BSV-16 & 17 are normally open)
But these valves also receive an open signal.

2.12 (1.0)

Answer: (b)

Reference: 1. STM 23-7
2. OP-502, p. 3
3. OP-408, Rev. 32

Delete BAW

~~2.13~~ ~~(1.0)~~

~~Answer: (c)~~

~~Reference: STM 22-13, 25, 39, 17.~~

2.14 (1.0)

Answer: (a)

Reference: STM-17-12, 12, 10, 10.
(b) - Must be manually stopped
(c) - No auto position
(d) - Has auto start

2.15 (1.0)

Answer: (b)

Reference: STM 17-4, 4, 5, 7.
(a) - MUV-48 is remotely operated
(c) - Closes MUV-49, not 40 & 41
(d) - makeups demins may be parallel or series

2.16 (1.0)

Answer: (b)

Reference: STM 10-2

2.17 (1.0)

Answer: (d)

Reference: STM-1-17 to 20

2.18 (1.0)

Answer: (b)

Reference: PASS Lesson Plan, RO-105

2.19 (2.0)

Answer: (See attached drawing)

1. Normal bypass inverter supplies (0.5)
2. Inverter feed to vital (0.3)
3. DC to inverter (0.3)
4. Two normal battery chargers (0.3)
5. One back up battery charger (0.3)
6. Bypass transformer and ~~switches~~ SW Solotron - voltage regulator (0.3)

2.20 (1.0)

Answer: (a)

Reference: OP-705, Rev. 3

2.21 (1.0)

Answer: (a)

Reference: OP-605, Rev. 28, pp 5 & 15

2.22 (1.0)

Answer: (b)

Reference: Site Fire Protection Systems
ANAO-39

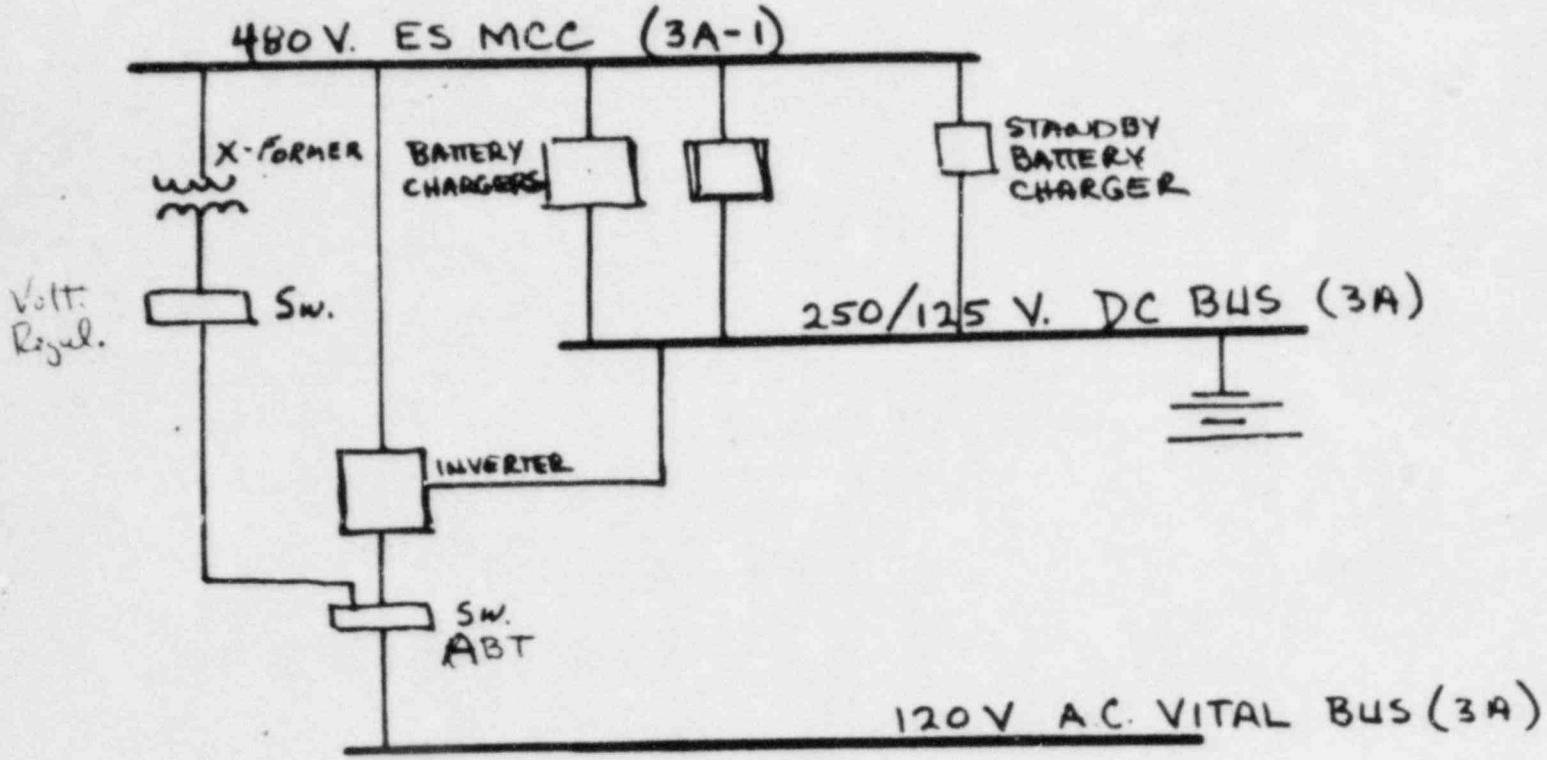

480 V. ES MCC (3A-1)
X-FORMER
BATTERY CHARGERS
STANDBY BATTERY CHARGER
Volt. Regul.
SW.
250/125 V. DC BUS (3A)
INVERTER
SW. ABT
120 V A.C. VITAL BUS (3A)

FIGURE 2.19

2.23 No pump operating — BW (1.0)

Answer: ~~One~~ Circulating Water Pump Operating, Condenser vacuum of ≥ 5" Hg ~~(or < 25")~~ BW

Reference: STM 13-18
Ref: STM. CH. 504, Rev 1/15/85, pg 110

2.24 (1.0)

Answer: a. TRUE
Reference: AP-380, pg. 9 (0.5)

b. TRUE
Reference: OP-404, pg. 5 (0.5)

ANSWERS 3.0 (25.0)

3.01 b (1.0)

Ref: OP-504, Rev. 7., pg. 3

3.02 c (1.0)

Ref: STM-13-34

3.03 c (1.0)

Ref: STM-12-11

3.04 a (1.0)

Ref: STM-20-2 (Separate Transmitters for DHV 3+4) OP-404, pg. 6, 7 (Alarm on DHV-41, no interlock)

3.05 d (1.0)

Ref: OP-504, Rev. 08, pg. 8

3.06 b (1.0)

Ref: Steam Line Rupture Matrix Handout, pg. 5

3.07 b (1.0)

Ref: SLRM Handout, pg. 9.

1. F (It resets the bypass)
3. F (It resets automatically)
4. F (Pushbuttons work anytime matrix is bypassed)

3.08 b (1.0)

Ref: STM-6-15, 17

3.09 c (1.0)

Ref: STM-43-17

3.10 d (1.0)
Ref: STM-43-7

3.11 a (1.0)

Ref: STM-[illegible]-24, 25

3.12 a (1.0)

Ref: STM-6-10, 11

3.13 d (1.0)

Ref: Power System Operation,
R. H. Miller, pg. 22-24

3.14 c (1.0)

Ref: Power System Operation,
R. H. Miller, pg. 22-23

3.15 a (1.0)

Ref: STM-10-36, 37

3.16 d (1.0)

Ref: STM-9-11-21
Also T. S. pg. 2-6

3.17 a (1.0)

Ref: STM: 28-22

3.18 b (1.0)

Ref: STM-10-56, 57

Delete per SW

~~3.19 b~~ ~~(1.0)~~

~~Ref: STM-2-121, 122~~

3.20 c (1.0)

Ref: STM-2-27, 28

3.21 d (1.0)

Ref: STM-17-17, 18

3.22 (2.0)

1. Reactor power > 30%
2. Oil lift pressure > 200 psig
3. NSCCCW Return Flow > 260 gpm/pump
4. Upper and lower oil Reserv. above low alarm
5. Seal Injection flow > 3 gpm/pump
6. Controlled bleed off valves (MUV-258/261) open
7. T_c > 500 °F to start 4th RCP

(5 answers req. - 0.4 each)

Ref: STM CH. 420, Rev. 1. pg. 19.
OP-302, Rev 21. pg 3

3.23 a.	Controlled bleed off temp. ≥ 170°F (Verified)	(0.5)
	High seal stage pressure drop ≥ 2/3 RCS pressure	(0.5)
b.	Total seal outflow exceeds 2.5 gpm	(0.5)
	and is <u>rapidly</u> increasing	(0.5)

Ref: OP-302, Rev. 21, pg 5

Answers 4.0 (25.0)

4.01 a - 3 Ref. AP-241 (2.5)
b - 4 Ref. AP-242 (0.5 each)
c - 5 Ref. AP-243
d - 2 Ref. AP-244
e - 1 Ref. AP-245

4.02 Notify Aux. Building Operator to ensure closed: (0.5)

WDV-891, WDV-892

Ref. AP-272

4.03 (b) (Establish OTSG levels w/MFP is a subseq. action) (1.0)
(d) — Also correct — This step was removed from Rev. 1
Ref. AP-330 — Rev. 1 issued on 3/6/85

4.04 (d) (1.0)
NS Seawater Pumps - RWP-2A/2B (Step 3)
DH Seawater Pumps - RWP-3A/3B (Step 6)

Ref: AP-380
STM-20-9 (RWP-3A/3B)
STM-4-10 (ECCS)
STM-23-2/3 (NSCW)

4.05 Notify AB operator to open affected BKG at MCC: (1.0)

(° Reactor 3A2) Not req. for full credit
(° Reactor 3B2)

Ref: AP-380, pg 4

4.06 a. 20 i. 100 (3.0)
b. 50 j. low level limit (30") (0.2 each)
c. 50 k. 50%
d. 1000 l. 95%
e. 20 m. 95%
f. 500 n. 0
g. 100 o. 2300
h. 10

Ref: AP-380, pg.

4.07 (a) (1.0)

Ref: OP-404, Rev. 45, pgs. 4 and 5

4.08 (c) (1.0)

Ref: OP-404, Rev. 45, pgs 2 and 3

4.09 (a) (1.0)

Ref: OP-408, Rev. 32, pg 3
(Incorrect statements)
b - 12 psig
c - 15 sec.
d - 15 sec.

4.10 (c) (1.0)

Ref: OP-408, Rev. 32, Section 10.2

4.11 (b) (1.0)

Ref: OP-501, Rev. 8, pgs. 2, 3 and 6

4.12 (d) (1.0)

Ref: OP-502, Rev. 13, pgs. 3-6

4.13 (d) (1.0)

Ref: OP-502, Rev 13, pg 3

4.14 (b) (1.0)

Ref: OP-504, Rev. 08, pg. 4

4.15 (a) (1.0)

Ref: OP-504, Rev. 08, pg. 7

4.16 (d) (1.0)

Ref: OP-605 pg. 21
STM 27-37

4.17 (b) (1.0)

Ref: OP-402, Rev. 43, pg. 4

4.18 (c) (1.0)

Ref: RP-101, Rev. 19, pg. 9

4.19 (b) (1.0)

Ref: RP-101, Rev. 19, pg. 13

4.20 (d) (1.0)

Ref: RP-101, Rev. 19, pgs. 21 and 22

4.21 1. Announce over the PA system that the Control Center is being evacuated. (1.5)

2. Transfer the 6900V and 4160 unit buses from the unit auxiliary transformer to unit startup transformer.

3. Trip the reactor from the MCB or remotely by opening 480V CRD breakers "A" and "B".

4. Depress "Reactor Trip" pushbutton AND perform Immediate Actions of AP-580.

5. Close FWV-161 and 162, EFW bypass valves.

6. Trip the main turbine and FWP's and assure EFWP's start and are controlling OTSG level.

Ref: AP-990, pg. 2

4.22 False (0.5)

Ref: AP-580 and EP-140