ENCLOSURE 1

EXAMINATION REPORT - 50-325/OL-84-01

Facility Licensee: Carolina Power and Light Company
411 Fayetteville Street
Raleigh, NC 27602

Facility Name: Brunswick Steam Electric Plant

Facility Docket No.: 50-324 and 50-325

Written, oral and simulator examinations were administered at Brunswick Steam Electric Plant near Southport, North Carolina.

Chief Examiner: John F. Munro — Date Signed: 2/1/85

Approved by: Bruce A. Wilson, Section Chief — Date Signed: 2/1/85

Summary:

Examinations on November 12-15, 1984

Written, oral and simulator examinations were administered to 15 candidates, 11 of whom passed.

REPORT DETAILS

1. Persons Examined:

SRO Candidates:

M. A. Magill
H. D. Wall
L. G. Zimmerman
R. M. Poulk
J. B. Raines
J. C. Reinsburrow
M. A. Schall
E. A. Bishop
J. P. Dimmette, Jr.

RO Candidates:

M. A. Barton
R. C. Godley
R. G. Long
M. Polischuk-Sawtshenko

Instructor Certification Candidates:

C. A. Casto
L. J. Sosler

Other Facility Employees Contacted:

*J. Chase, Operations Manager
*P. Hopkins, Training Supervisor
*T. Backes, Sr. Specialist - Simulator Support
#*N. Stewart, Sr. Specialist - Operator Training
#*S. Morgan, Sr. Specialist - Operator Training
#D. Shaw, Sr. Specialist - Operator Training
#*G. Barnes, Sr. Specialist - Operator Training

#Attended Written Examination Review

*Attended Exit Meeting

2. Examiners:

*J. Munro, NRC
S. Guenther, NRC
K. Brockman, NRC
J. Kvamme, EG&G
T. Morgan, EG&G

*Chief Examiner

3. At the conclusion of the written examinations, the examiners met with facility representatives (identified in (1) above) to review the written examinations and answer keys. The following comments were made by the facility reviewers:

   a. SRO Exam

      (1) Question 5.1 - The question deals with four statements about LHGR. The third statement said that the LHGR limit decreased over core lifetime; this is not true. According to Technical Specification 3/4.2.4, the LHGR limit is 13.4 kw/ft for 8x8, 8x8R, P8x8R, and BP8x8R fuel assemblies. No limit change is addressed for core age for LHGR.

      The test question should have two possible correct selections:

      a) The answer dealing with 2200°F fuel temperature.

      b) The answer that says that the LHGR limit decreases with core age.

      Resolution - The LHGR "design limit" for 8x8 fuel is 13.4 kw/ft as stated in BSEP Technical Specification 3/4.2.4 and in the BSEP "Core Parameters and Thermal Limits" study guide. This "design limit" is not dependent on fuel exposure. The LHGR "Safety Limit", as defined in the BSEP study guide, corresponds to 1% plastic strain on the cladding and must always remain greater than the "LHGR design [TS] limit + delta LHGR of worst transient." As stated in question 5.1, choice (c), and confirmed in the BSEP study guide, this "Safety Limit" does decrease with fuel exposure. Consequently, no change to the answer key is warranted.

      (2) Question 6.5 - The question deals with what signals will give a Group I isolation in startup with reactor power at 5%.

      Answer "A" is most correct.

      Answer "C" could be correct if the bypass/test switch is out of bypass in startup when reactor pressure is greater than 500 psig. Reference Technical Specification 3/4.3.2.

      Resolution - Technical Specification Table 3.3.2-1 and Facility Drawing No. 791E401RL confirm the accuracy of the above statement. The answer key has been changed accordingly. This answer was derived from facility-supplied System Description No. SD-12. The SD should be corrected to reflect the existing plant conditions.

      (3) Question 6.9b - The question deals with the method of minimizing corrosion in the vital service water header. Your answer stated well water lay-up as the correct answer. Recently, the plant completed modifications which bypass the isolation valves around

room coolers and allow a constant flow through the system. Reference Plant Modifications 79-232 C & D and Plant Drawing 9527-D-2537.

Resolution - Plant Modifications 79-232 C & D and Facility Drawing No. 9527-D-2537 confirm the accuracy of the above statement. The answer key has been changed accordingly.

(4) Question 8.1 - The question deals with valve line-up verification. A recent Plant Operating Manual change extends the time of the last valve line-up done from one year to the last refuel cycle. Reference GP-01, Revision 95.

Resolution - Revision 95 of procedure GP-01 confirms the accuracy of the above statement. The answer key has been changed accordingly.

(5) Question 8.11 - The question deals with who holds and controls the keys for high radiation areas in excess of 1000 mRem. Technical Specifications reference the Operations Shift Foreman and the Radiation Control Supervisor. AI-40," High Radiation Area Key Control," also references the Shift Operating Supervisor or Shift Foreman for operating personnel; the Radiation Control Supervisor for other personnel.

Resolution - The E&RC Manual, referenced in the original answer key, did not indicate dual control of high radiation area keys by the SOS/SF and the E&RC Supervisor. Technical Specification 6.12 and Procedure AI-40 confirm dual key control. The answer key has been changed accordingly.

b. RO Exam

(1) Question 1.01 (c) - Answers should be 1-False, 2-False, 3-True and 4-True for .25 Points each.

Resolution - The answer key was incorrect in this instance due to typographical errors and has been corrected accordingly.

(2) Question 1.02 - The failure of the Bypass Valves (BPVs) may have been caused by the fire/power loss, but the graphs do not necessarily pin-point the BPV Failure.

Resolution - A careful analysis of the following Figure 1 graphs and the "abnormal" conditions depicted by them provide sufficient information for the candidate to conclude that the Bypass Valves in the reactor pressure control system failed to open.

- Reactor Pressure (WR): Reactor Pressure is oscillating at approximately 1100 psig. This pressure is excessive and indicates cycling SRVs as the pressure control mechanism.

- Reactor Vessel Level: Level spikes are indicative of repeated voiding and void collapse. This phenomenon re-enforces the conclusion that the SRVs are cycling.

- Total Steam Flow: The instantaneous drop to zero flow is abnormal and indicates that the BPVs did not open following the turbine trip and are not controlling reactor pressure as would be expected.

No change to the answer key is warranted.

(3) Question 1.05 - The question assumes that the 118% scram is the only APRM scram. If the candidate assumes there is a 120% instant scram from the APRM, the answer may be slightly different.

Resolution - The use of the 120% "Instant Scram" APRM setpoint in the answer calculation would not be consistent with the question's stated scram time delay of 10 seconds. The signal for this setpoint incorporates no time constant circuit (delay) but responds directly to instantaneous neutron flux. No change to the answer key is warranted.

(4) Question 2.02 (c) - At 1000 psig reactor pressure the accumulator will still give the CRD its initial boost for the scram.

Resolution - Facility System Description No. SD-08 supports the accuracy of the above statement. This statement has been added to the answer.

(5) Question 2.06 (a) - Additional answers may also be "flashing (to steam), depressurizing, and water hammer in the RWCU system (as the Dump-Reject Valve cycles open/closed due to the 5 psig pressure trip)."

Resolution - These alternative answers are considered acceptable equivalents/substitutes for the adverse result provided in the answer key. The answer key has been changed accordingly.

(6) Question 3.03 (c) - The reference for instrument zero is based on 367 inches above vessel zero (bottom of vessel), and is defined as a point 4.38 inches below the upper core grid. We do not reference level above the fuel because of the different types of fuel that are in the core. Reference - RO/SRO Requal program material, RTN 008, Page 4.

Resolution - The question requested the reference point with respect to the "Top of Active Fuel" for a specific fuel type, "8 X 8 R" Fuel. The question is straightforward and verbatim from facility-supplied student training material. No change to the answer key is warranted.

(7) Question 3.05 - The set points given may be identified as Technical Specification numbers, which are not the same as cal folder numbers.

Resolution - The question specifically requested the more conservative "actual" setpoints for automatic initiation. No change to the answer key is warranted.

(8) Question 3.10 (a) - The turbine control valves have a 100% "steam flow" signal vice a 100% open signal. The TCVs will not move. The answer from the candidates may reflect this.

Resolution - This comment is a technically appropriate clarification to the answer. The answer key has been changed accordingly.

(9) Question 4.03 (b) - There is no Recirc Pump trip if the discharge valve is shut. We still have the discharge valve bypass, and the pump will run back to 28% speed if the number one limiter is picked up. This limiter is activated if either (1) the discharge valve is shut or (2) total feed flow is less than 20%.

Resolution - Facility Procedure OP-02 and the Recirculation System Study Guide support the accuracy of the above statement. The answer key has been changed accordingly.

(10) Question 4.04 - High bearing vibration at any time should also necessitate an operator turbine trip and not just at "critical" speeds.

Resolution - Facility Procedure GP-03 and sound engineering judgement support tripping the turbine with high vibration at any speed. The answer key has been changed accordingly.

(11) Question 4.05 (a and b) - The terms RC/L, RC/P, and RC/Q are from the "Owner's Group Guidelines" and although we use the intent of these terms, we do not use the terms as they are written in the "Owner's Group Guidelines." The entry conditions for "RPV Control" are also from the "Owner's Group Guidelines" and again we treat these differently. We use the 5 "key parameters" located at the top of each flow chart, and ask the questions about level, press, etc. later in the flow path. This question is a good SRO-type question if it is re-written in the BSEP format.

Resolution - Although the terms are not directly utilized by procedure EOP-01, the purposes/concepts represented by these terms are integrated into EOP-01 and its associated "User's Guide." Consequently, candidates should have a familiarity with these purposes. No change to the answer key for part (a) is warranted. An error was made in the interpretation of the EOP-01 "User's Guide" with respect to the distinction between the terms "entry conditions" and "key parameters." This error was attributable, in

part to the facility's failure to forward the EOP-01 flowcharts, and demonstrates the need for the facility to insure that all submitted reference material is complete. The answer key for part (b) has been changed accordingly.

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 examination. Those individuals who clearly passed the oral and simulator examinations were identified.

There was one generic weakness (greater than 75% of candidates) noted during the simulator demonstration examinations. The area of weak performance was the tendency of the candidates to periodically "lock-in" on the EOP-01 Procedure Flowcharts and become unaware of important parameter and plant condition changes during abnormal transient conditions. This item will be identified as Inspector Followup Item E4-01-01. The cooperation given to the examiners and the effort to ensure a control room atmosphere conducive to the conduct of oral examinations was appreciated and noted.

SRO EXAM COMMENTS

1. Question 5.1 deals with four statements about LHGR. The third statement said that the LHGR limit decreased over core lifetime; this is not true. According to Technical Specifications 3/4.2.4 the LHGR limit is 13.4 kw/ft for 8x8, 8x8R, P8x8r, and BP8x8R fuel assemblies. No limit change is addressed for core age for LHGR.

   The test question should have two possible correct selections:

   a. The answer dealing with 2200°F fuel temperature.

   b. The answer that says that LHGR limit decreases with core age.

2. Question 6.5 deals with what signals will give a Group I isolation in startup with reactor power at 5%.

   Answer "A" is most correct.

   Answer "C" could be correct if bypass/test switch is out of bypass in startup when reactor pressure is greater than 500 psig. Reference Technical Specifications 3/4 3.2.

3. Question 6.9b, this question deals with the method of minimizing corrosion in the vital service water header. Your answer stated well water lay-up as the correct answer. Recently the plant completed Modification 79-232C & D which bypasses isolation valve around room coolers which allows a constant flow through the system. Reference Plant Modifications 79-232 C & D and Plant Drawing 9527-D-2537.

4. Question 8.1, this question deals with valve line-up verification. A recent Plant Operating Manual change extends the time of the last valve line-up done from one year to the last refuel cycle.

   Reference GP-1, Revision 95

5. Question 8.11, this question deals with who holds and controls the keys for High Radiation areas in excess of 1000 mRem. Technical Specifications references Operations Shift Foremen and the Radiation Control Supervisor. AI-40 High Radiation Area Key Control also references the Shift Operating Supervisor/or Shift Foreman for Operating personnel, Radiation Control Supervisor for other personnel.

PARAMETERS LOCATED AT THE TOP OF EACH FLOW CHART, AND
ASK THE QUESTIONS ABOUT LEVEL, PRESS ETC LATER IN THE FLOW PATH.
THIS QUESTION IS A GOOD SRO TYPE QUESTION IF IT IS RE-WRITTEN
IN THE BSEP FORMAT.

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REACTOR OPERATOR EXAM COMMENTS 11-12-84

Q 1.01C
ANSWERS SHOULD BE 1-F 2-F 3-T 4-T, PTS .25 EACH

Q 1.02
FAILURE OF THE BYPASS VALVES MAY HAVE BEEN CAUSED BY THE FIRE/POWER LOSS; BUT THE GRAPHS DO NOT NECESSARILY PIN-POINT THE BPV FAILURE.

Q 1.05
THE QUESTION ASSUMES THAT THE 118% SCRAM IS THE ONLY APRM SCRAM. IF THE CANDIDATE ASSUMES THERE IS A 120% INSTANT SCRAM FROM THE APRM, THE ANSWER MAY BE SLIGHTLY DIFFERENT.

Q 2.02C
AT 1000# RX PRESSURE THE ACCUMULATOR WILL STILL GIVE THE CRD IT'S INITIAL BOOST FOR THE SCRAM.

Q 2.06A
MAY ALSO BE ANSWERED AS FLASHING, DEPRESSURIZING, AND WATER HAMMER OCCURS IN THE RWCU SYSTEM WITH THE DUMP (REJECT) VALVE CYCLING OPEN/CLOSED DUE TO THE 5# PRESSURE TRIP.

Q 3.03C
THE REFERENCE FOR INSTRUMENT '0' IS BASED ON 367" ABOVE VESSEL '0' (BOTTOM OF VESSEL), AND IS DEFINED AS A POINT 4.38" BELOW THE TOP OF THE UPPER CORE GRID. WE DO NOT REFERENCE LEVEL ABOVE THE FL BECAUSE OF THE DIFFERENT 'TYPES' OF FUEL THAT ARE IN THE CORE. REFERENCE RO/SRO REQUAL PROGRAM MATERIAL RTN 009 PAGE 4

Q 3.05
SET POINTS GIVEN MAY BE IDENTIFIED AS TECH SPEC NUMBERS, WHICH ARE NOT THE SAME AS CAL FOLDER NUMBERS.

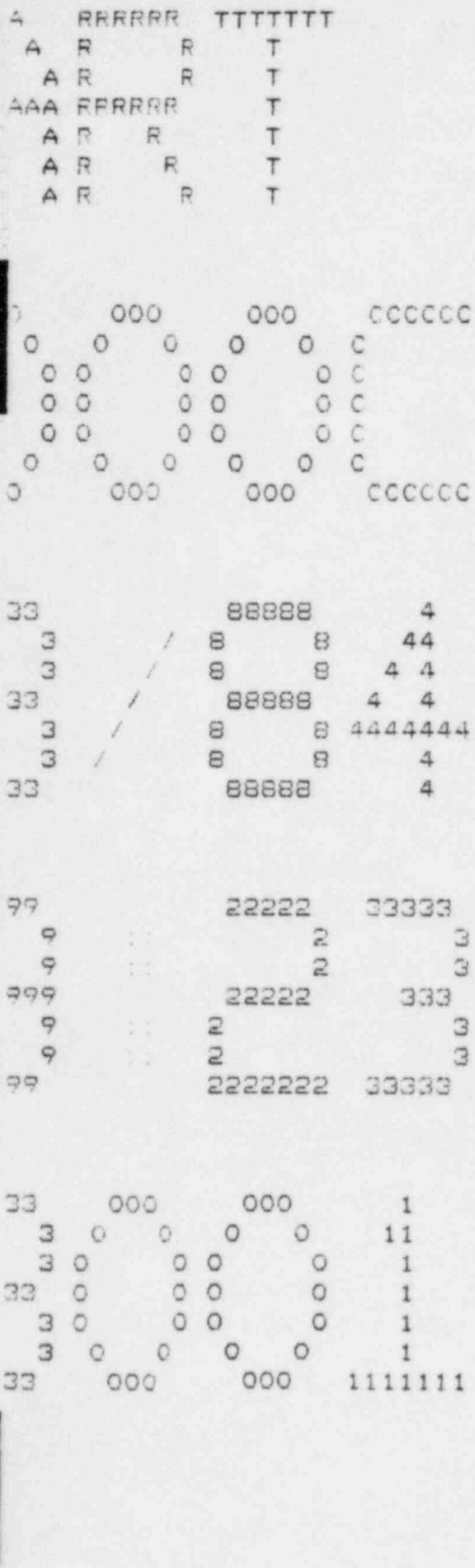
Q 3.10A
THE TURBINE CONTROL VALVES HAVE A 100% 'STEAM FLOW" SIGNAL VS A 100% OPEN SIGNAL. THE TCV'S WILL NOT MOVE, THE ANSWER FROM THE CANDIDATE MAY REFLECT THIS.

Q 4.03B
THERE IS NO RECIRC PUMP TRIP IF THE DISCHARGE VALVE IS SHUT. WE STILL HAVE THE DISC VALVE BYPASS, AND THE PUMP WILL RUN BACK TO ^ 28% SPEED IF THE NUMBER ONE LIMITER IS PICKED UP. THIS LIMITER IS ACTIVATED IF EITHER 1) THE DISC VALVE IS SHUT , OR 2) TOTAL FEED FLOW IS <20%.

Q 4.04 #2
HIGH BEARING VIBRATION AT ANYTIME NOT JUST AT 'CRITICAL' SPEEDS.

Q 4.05 A AND B
THE TERM'S RC/L, RC/P, RC/Q ARE FROM THE OWNER'S GROUP GUIDLINES ALTHOUGH WE USE THE INTENT OF THESE TERMS WE DO NOT USE THE TERMS AS THEY ARE WRITTEN IN THE OWNER'S GROUP GUIDELINES.
THE ENTRY CONDITIONS FOR 'RPV CONTROL' ARE ALSO FROM THE OGL AND AGAIN WE TREAT THESE DIFFERENTLY. WE USE THE 5 KEY

GOULD S.E.L. MPX-32 1.5B



GOULD S.E.L. MPX-32 1.0B

Enclosure 3
(1 of 2)

MASTER COPY

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: BRUNSWICK 1&2

REACTOR TYPE: BWR-GE4

DATE ADMINISTERED: 84/11/13

EXAMINER: KWAMUE J.

APPLICANT: _____

INSTRUCTIONS TO APPLICANT:

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

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

FINAL GRADE _____%

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

Reviewed By 11/12/84.
M. Stewart
O.F.S.

_____
APPLICANT'S SIGNATURE

QUESTION 1.01 (2.75)

A. Identify which isotopes and what percentage each contribute to the total core power both at Beginning of Life (BOL) and End of Life (EOL). (1.5)

B. The percentage of delayed neutrons born at THERMAL energy levels is approximately: (.25)

1. 99.6%
2. 64%
3. 0.64%
4. 0%
5. 70 %

C. Indicate if the below statements are TRUE or FALSE. (1.0)

1. On an average, about 20 MEV of energy is released per fission in the core.
2. The Fission Yield Curve tells how much energy is released for each isotope that can fission.
3. Prompt neutrons constitute over 99% of the neutrons produced through nuclear fission.
4. Prompt neutrons which accompany the fission process are actually released within a period of .000001 seconds.

QUESTION 1.02 (4.00)

Unit 2 is operating at 100% power. A fire is reported in the Front Standard of the Main Turbine. The Reactor Operator depresses the 'TRIP' push button on the EHC control panel. A failure occurs at this time. Using the attached traces of the various plant parameters, Figure 1, indicate WHAT FAILURE has occurred with the Main Steam and Turbine System. In addition EXPLAIN the CAUSE of the recorder indication changes at each of the numbered points as described below: (1.0)

NOTE: 1. Time intervals are 30 seconds.
2. The operator depresses the 'TRIP' push button at +25 seconds.

a. The sharp drop in reactor vessel water level. (.75)

b. The sharp drop in reactor power. (.75)

c. The repeated rise and fall in vessel water level. (.75)

d. The drop in total steam flow to near zero. (.75)

QUESTION 1.03 (1.75)

A hot reactor is increased in power by withdrawing control rods. The void fraction increases 1.5% and fuel temperature increases 40 degrees F. Assuming no change in moderator temperature, what was the reactivity worth of the control rod? Show all work and state any assumptions you make. (1.75)

QUESTION 1.04 (2.00)

Following a normal reduction in power from 90% to 70% with recirculation flow, HOW will the following change (increase, decrease, or remain the same) AND WHY:

a. The pressure difference between the reactor and the turbine steam chest. (1.0)

b. Condensate depression at the exit of the condenser. (1.0)

QUESTION 1.05 (2.00)

Unit 1 is operating at 2436 MW (100% of rated), and the reactor scram is set for 118% of rated. The total scram delay time is 10 seconds, measured from the time the scram setpoint is exceeded until sufficient negative reactivity has been added to turn power. If a nuclear excursion creates a 10 second period, WHAT will be the peak power for the excursion? NOTE: 1.Assume NO temperature or void effects. 2.Assume a constant period until power turns. (2.0)

QUESTION 1.06 (3.00)

Concerning THERMAL LIMITS:

a. Since MCPR is not a directly measurable parameter, WHAT are THREE (3) measurable core parameters needed by the process computer to calculate MCPR? (1.0)

b. With regard to MAPRAT: (2.0)
   1. WHAT is the RELATIONSHIP between MAPRAT & MAPLHGR?
   2. The process computer prints out a MAPRAT of 1.03. Is this acceptable?
   3. WHAT physical consequence could occur if the MAPRAT limit is exceeded?

QUESTION 1.07 (2.00)

The reactor has been operating at 90% power for several days. An operator RAPIDLY reduces reactor power to 60% by reducing the speed of the recirculation pumps. During the next FEW MINUTES (2-3 minutes) the operator notices that reactor power slowly increases approximately 3%. EXPLAIN the cause of this effect.

QUESTION 1.08 (2.00)

The reactor has just scrammed from extended full power operation. Ten (10) hours later cooldown is complete, and at that time the Shutdown Margin is measured to be 1%. DESCRIBE the changes, if any, to the Shutdown Margin in the NEXT 20 hours.

NOTE: Address in your discussion whether a reactor restart is a concern. (2.0)

QUESTION 1.09 (1.00)

During high power operation, a slow decrease in main condenser vacuum occurs. LIST FOUR (4) things which could be causing this decrease. (1.0)

QUESTION 1.10 (2.50)

A. EXPLAIN what is meant by cavitation. (Include WHAT it is and WHAT CAUSES it.) (1.0)

B. What are THREE (3) major parameters affecting the Net Positive Suction Head (NPSH) of a centrifugal pump? (1.5)

QUESTION 1.11 (2.00)

For each of the events listed below, state WHICH reactivity coefficient will respond first, WHY it responds, and if it ADDS positive or negative reactivity.

A. SRV opening at 100% power. (1.0)
B. Rod drop at 100% power. (1.0)

QUESTION 2.01 (3.00)

a. DESCRIBE the flow path for fuel pool water during the 'FPCC ASSIST' mode of the RHR system. Note: Be specific and include major components. (A drawing may be used) (1.5)

b. GIVE TWO (2) design features that prevent the possibility of draining the water from the spent fuel storage pool below the top of the fuel stored there. (1.5)

QUESTION 2.02 (3.00)

INDICATE the TWO (2) sources of control rod scram hydraulic pressure AND DISCUSS HOW these two sources are effective in causing a scram at:

a. Zero reactor pressure

b. 400 psig reactor pressure

c. 1000 psig reactor pressure

QUESTION 2.03 (3.00)

A. The Turbine Building Closed Cooling Water (TBCCW) cools numerous components. Of these, Four (4) components are oil coolers. Identify these Four (4) different oil coolers. (2.0)

B. All of the components in Part a have individual temperature control. WHY would these components (oil coolers) need individual temperature control and others would not? (1.0)

QUESTION 2.04 (4.00)

For the following systems LIST and DISCUSS the PURPOSE and LOCATION of all INTERFACES with the Recirculation System.

A. Residual Heat Removal (RHR) (NOTE: Discuss TWO modes of RHR) (2.0)
B. Reactor Water Cleanup (RWCU) (0.5)
C. Reactor Building Closed Cooling Water (RBCCW) (1.0)
D. CRD Hydraulics (0.5)

QUESTION 2.05 (3.00)

EXPLAIN HOW and WHY a loss of the Uninterruptible Power Supply (UPS) affects each of the following items. If the loss has no effect, explain what prevents the loss from having an effect. Note: If there is a difference between units SPECIFY.

A. Condenser Vacuum (1.0)
B. Feedwater Control (1.0)
C. EHC (1.0)

QUESTION 2.06 (3.00)

For the following situations concerning the Unit 2 Reactor Water Cleanup (RWCU) system, WHAT will be the ADVERSE RESULT of each situation?

A. RWCU is being operated in the reject mode to the main condenser when a system isolation occurs and the rejection isolation valve is not promptly shut by the operator. (1.0)

B. During RWCU system startup, a RWCU pump is vented while running. (1.0)

C. During reject operations at 50% Reactor Power, both reject valves, G31-F035 to radwaste and G31-F034 to the main condenser are opened simultaneously while changing reject flow paths. (1.0)

QUESTION 2.07 (2.50)

Explain the operation of an Extraction Steam System NON RETURN VALVE (NRV). Your explanation should address the following:

-Purpose (.75)
-Normal operation (.75)
-Operation on a Turbine Trip (1.0)

QUESTION 2.08 (1.50)

What are the three conditions necessary to satisfy the RHR Shutdown Cooling Valve Interlocks and allow opening F008 and F009, the RHR Suction Cooling Isolation Outboard and Inboard Valves? INCLUDE VALUES OR SETPOINTS. (1.5)

QUESTION 2.09 (2.00)

A. What affect (if any) on Diesel Generator OPERABILITY would occur if the diesel mode selector switch were placed in the 'CONTROL ROOM MANUAL' position and left there? EXPLAIN. (1.0)

B. What affect (if any) on D/G OPERABILITY would occur if the diesel tripped on reverse power during testing and was left to sit in that condition? EXPLAIN. (1.0)

QUESTION 3.01 (3.00)

A. F-010, F-029 and F-031, suction valves to the RCIC pump from the CST and Suppression Pool respectively , are all CLOSED and a RCIC initiation signal is received. Will the RCIC system initiate? EXPLAIN. Note: Your answer should address each of the above valves. (1.5)

B. Indicate whether the following statements are TRUE or FALSE. If false, EXPLAIN WHY.

1. If the RCIC turbine is tripped by the mechanical overspeed trip, the motor operator for the 'Trip and Throttle' valve V-8 will still go to the CLOSE position if the V-8 control switch is positioned to CLOSE. (.5)

2. To restore remote control of V-8 after a mechanical trip, the overspeed trip must be manually reset. (.5)

3. The mechanical overspeed set limit is 150%. (.5)

QUESTION 3.02 (2.00)

List FOUR (4) automatic actions that occur on a Group 1 Containment Isolation caused from a Hi-Hi Main Steam Line Radiation Trip. (2.0)

QUESTION 3.03 (2.50)

A. Which level transmitter arrangement (temperature compensated or uncompensated) is more likely to reach boiling in the indicating columns in the event of a Drywell temperature increase and reactor pressure decrease? (.5)

B. Which level indication(s) at the RTGB are temperature compensated? (.5)

C. The reference point used in the vessel level indicating system is _____ inches above TAF for 8X8R fuel. (.5)

D. At 100% power, what is the relationship between indicated level and actual level in the core? EXPLAIN. (1.0)

QUESTION 3.04 (2.00)

The plant is operating at 100% power. APRM channels A and C have failed high. You call the I&C Technician to investigate while you research Tech. Specs. A Plant Auxiliary Operator wants to shift RPS B power supply to its alternate power source for training. WOULD you let him? EXPLAIN why or why not. Direct your answer toward system(s) response(s) instead of administrative requirements. (2.0)

QUESTION 3.05 (3.50)

A. LIST the Conditions which will cause the Unit 2 Standby Gas Treatment (SBGT) to start automatically. (ACTUAL setpoints required) (2.0)

B. Indicate if the following statements are TRUE or FALSE:

1. Manual startup of the SBGT system will NOT cause the Reactor Building Ventilation System to isolate. (.5)

2. Automatic start of a SBGT train is only possible with the control switch in the "STANDBY" position. (.5)

3. Temperature switches located in the carbon filter banks will initiate cooling air at 210 F and secure the fan and heater. (.5)

QUESTION 3.06 (2.50)

The Reactor is operating at 40% power with the Feedwater Control System in single element control, and channel A selected for input (C32-N004A), when the reference leg isolation valve to (C32-N004A) develops a significant packing leak and the associated reference leg starts to gradually decrease. Describe what will happen to the plant and why. Assume no operator action. Figure 32.2-5- Feedwater Level Control, Figure 10- Rosemount and GEMAC Level Instrument, and Figure 12- Unit 1 Rosemount Level Instrument are attached for your reference. (NOTE: Limit your answer to effects on end of FWLC, RPS, Level Indicating, and Level Actual)
ANSWER ON THE ATTACHED HANDOUT PAGE.

QUESTION 3.07 (1.50)

CONCERNING THE RBM:

A. Name THREE (3) other system input to the ROD BLOCK MONITOR (RBM)? (NOTE: Exclude power supplies.) (1.0)

B. Identify if the below statement is TRUE or FALSE. (.5)

When power is increased within 2% of the Low or Intermediate setpoint of the Rod Block Trip Unit, the operator receives a warning of a pending Rod Block (push to set up).

QUESTION 3.08 (3.00)

For each of the IRM (Intermediate Range Monitoring) range changes below, provide the following:

1. The indicated level on the NEW RANGE.
2. All automatic actions initiated as a result of the indicated level on the NEW RANGE.

A. Switching from range 5, reading 25, up to range 7. (1.5)
B. Switching from range 6, reading 39, down to range 5. (1.5)

A copy of IRM scale readings is provided.

QUESTION 3.09 (2.50)

A. An operator depresses a pushbutton for a desired rod on the rod select pushbutton matrix. Which of the below events does NOT occur as a result of this action: (0.5)

1. deselects any other rod select pushbutton previously selected

2. energizes its own latch relay, which magnetically latches the switch contacts in the depressed position

3. contacts close which connect the backlight circuit of the pushbutton select switch to the RSCS lamp dimmer circuit

4. rod worth minimizer is reinitialized.

B. Using the attached Fig. 4, CRD Hydraulic System, select the correct word in parenthesis to fill in the blanks of the below description of a Control Rod Notch Out Sequence. (2.0)

Notch out begins with a brief _____(downward/upward) movement to unlock the control rod. When the control switch is kept in the 'NOTCH OUT' position, the HCU insert directional control valves _____(energize/deenergize) and open at .02 seconds and the CRD hydraulic stabilizing valve _____(energizes/deenergizes) and _____(opens/closes). The CRD index tube drives _____ (down/up) and comes out of the collet lock. At _____(0.64/6.8) seconds the insert directional control valve _____(deenergizes/ energizes) and closes. The stabilizing valve then _____ (deenergizes/energizes) and _____(closes/opens). During rod movement the sequence timer is going through its cycle which it completes and resets in _____(18.4/8.5) seconds.

QUESTION 3.10 (2.50)

With the plant operating at 100% power with the recirc in Master Manual, an operator inadvertantly DECREASES the 'Pressure Set' by 5 psi. WHAT will be the INITIAL response and FINAL status of the following parameters due to this action? Briefly EXPLAIN. Assume NO operator action. See Figure 2, EHC Logic Diagram. ANSWER on the attached handout page.

A. TCV position
B. BPV position
C. POWER
D. PRESSURE

QUESTION 4.01 (2.75)

A. Fill in the blanks in the below statement in accordance with 'Operating Principles and Philosophy of LOG REVIEWS':

'It is important when taking and reviewing log data, that the operator involved take time to consider the recorded values for _____ and compare to other readings for _____ with present plant status.' (1.0)

B. There are several annunciators on each unit which have a special annunciator card identified by a 'yellow dot' on the annunciator window. WHEN would an annunciator have a 'yellow dot'? (1.75)

QUESTION 4.02 (3.50)

Concerning GP-02, 'Approach to Criticality and Pressurization of The Reactor':

A. HOW and WHEN is coupling integrity of a control rod checked? (1.5)

B. MATCH the list of Startup Actions in column 1 with its approximate time during the startup in column 2. (2.0)

COLUMN 1	COLUMN 2
1. Close the reactor head vents	a. Rx pressure > 60 psig
2. Test the operation of the Low Condenser Vacuum switches	b. Coolant temp < 212 F c. Rx pressure = 380 psig d. Condenser vacuum > 12" Hg
3. Commence shell warming of the Main Turbine	e. Rx pressure ~ 200 psig f. Rx power ~ 15%
4. Place SJAE in service	

QUESTION 4.03 (2.50)

The A and B recirculation pumps are being controlled from their respective M/A Transfer Stations in 'Manual' for a test.

A. If the 'A' pump is at 70% speed, what is the maximum and minimum speeds that the 'B' pump can be operated by procedure? (1.0)

B. If both pumps were at 70% speed, WHAT would occur and WHAT is the REASON for this action if the discharge valve on the 'B' pump were SHUT? (1.5)

QUESTION 4.04 (3.00)

The Main Turbine is on a roll up (increasing speed) to 1800 RPM. LIST FOUR (4) of five conditions that could occur where the operator should 'Trip the Turbine' in accordance with OP-03 "Unit Startup and Syncronization". (NOTE: Specific setpoints are not required.) (3.0)

QUESTION 4.05 (4.00)

Regarding Emergency Operating Procedure 1 (EOP-1):

a. Briefly describe the purpose of RC/L, RC/P, AND RC/Q. (1.5)

b. WHAT are the FIVE (5) entry conditions for Reactor Pressure Vessel control in accordance with the EOP Users Guide? (2.5)

QUESTION 4.06 (3.00)

During high power operations a failure to scram occurs. The decision to inject Standby Liquid Control (SLC) is made. Both SLC pumps fail to start. BRIEFLY describe TWO (2) possible flow paths you could establish using DIFFERENT SYSTEMS to inject the contents of the SLC Storage Tank into the vessel. (3.0)

QUESTION 4.07 (3.00)

A. What are the THREE (3) entry conditions for EMERGENCY DEPRESSURIZATION Procedure EOP-01-EDP? (1.5)

B. If the MSIV's are closed due to reactor vessel being below +112 and the main condenser is available as a heat sink, is it possible to use the main condenser to depressurize the plant? BRIEFLY EXPLAIN. (1.5)

QUESTION 4.08 (3.25)

A. A fire of unknown sources breaks out in the Control Room resulting in heavy smoke. The Shift Foreman makes the decision to evacuate the Control Room. As the Unit Control Operator what action(s) should you take prior to leaving the Control Room? (2.0)

B. If you could take no action(s) prior to leaving the Control Room, what TWO action(s) would you take outside the Control Room and WHERE would you take them? (1.25)

EQUATION SHEET

$F = ma$

$v = s/t$

Cycle efficiency = (Net work out)/(Energy in)

$w = mg$

$s = V_o t + 1/2\ at^2$

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$ $\quad A = A_o e^{-\lambda t}$

$PE = mgn$

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

$V_f = V_o + at$

$w = \theta/t$

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

$W = v\ \Delta P$

$A = \dfrac{\pi D^2}{4}$

$\Delta E = 931\ \Delta m$

$\dot{m} = V_{av} A_o$

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

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

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

$Pwr = W_f \Delta h$

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

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

$TVL = 1.3/\mu$

$HVL = -0.693/\mu$

$P = P_o 10^{sur(t)}$

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

$SUR = 26.06/T$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

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

$P = (\Sigma\phi V)/(3 \times 10^{10})$

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

$\Sigma = \sigma N$

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

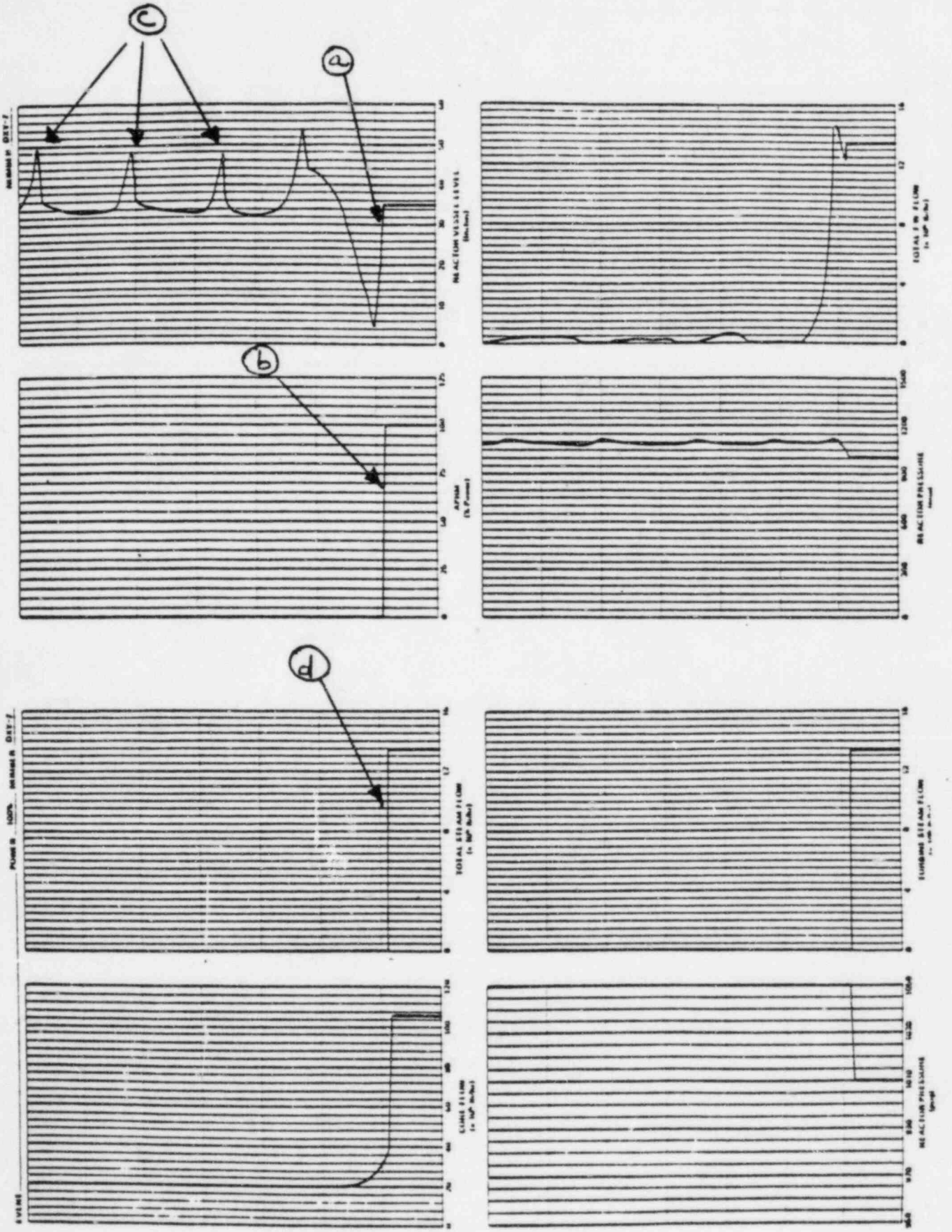


FIGURE 1

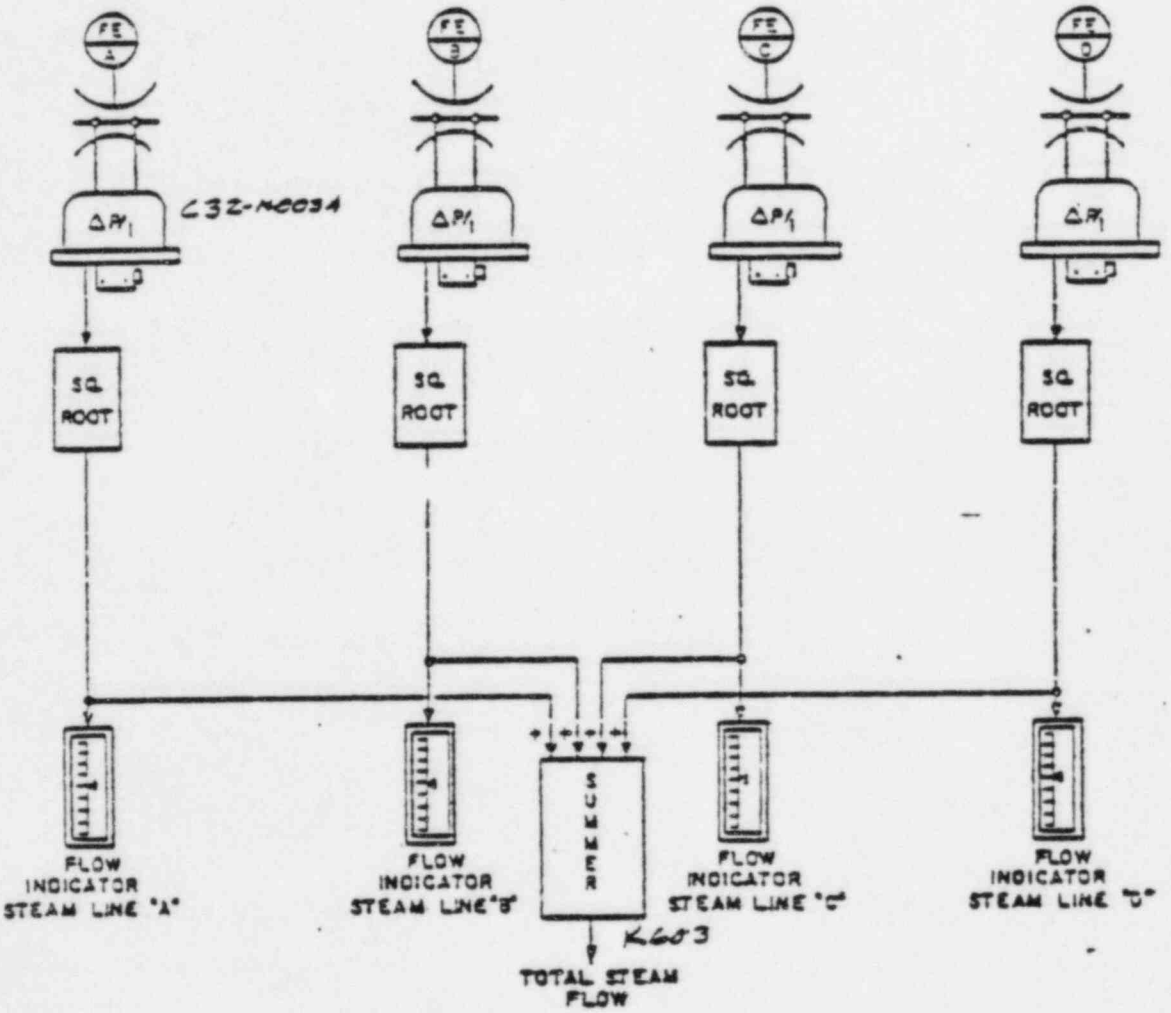


FIGURE 32.2-4

STEAM FLOW MEASUREMENT WITHOUT DENSITY COMPENSATION

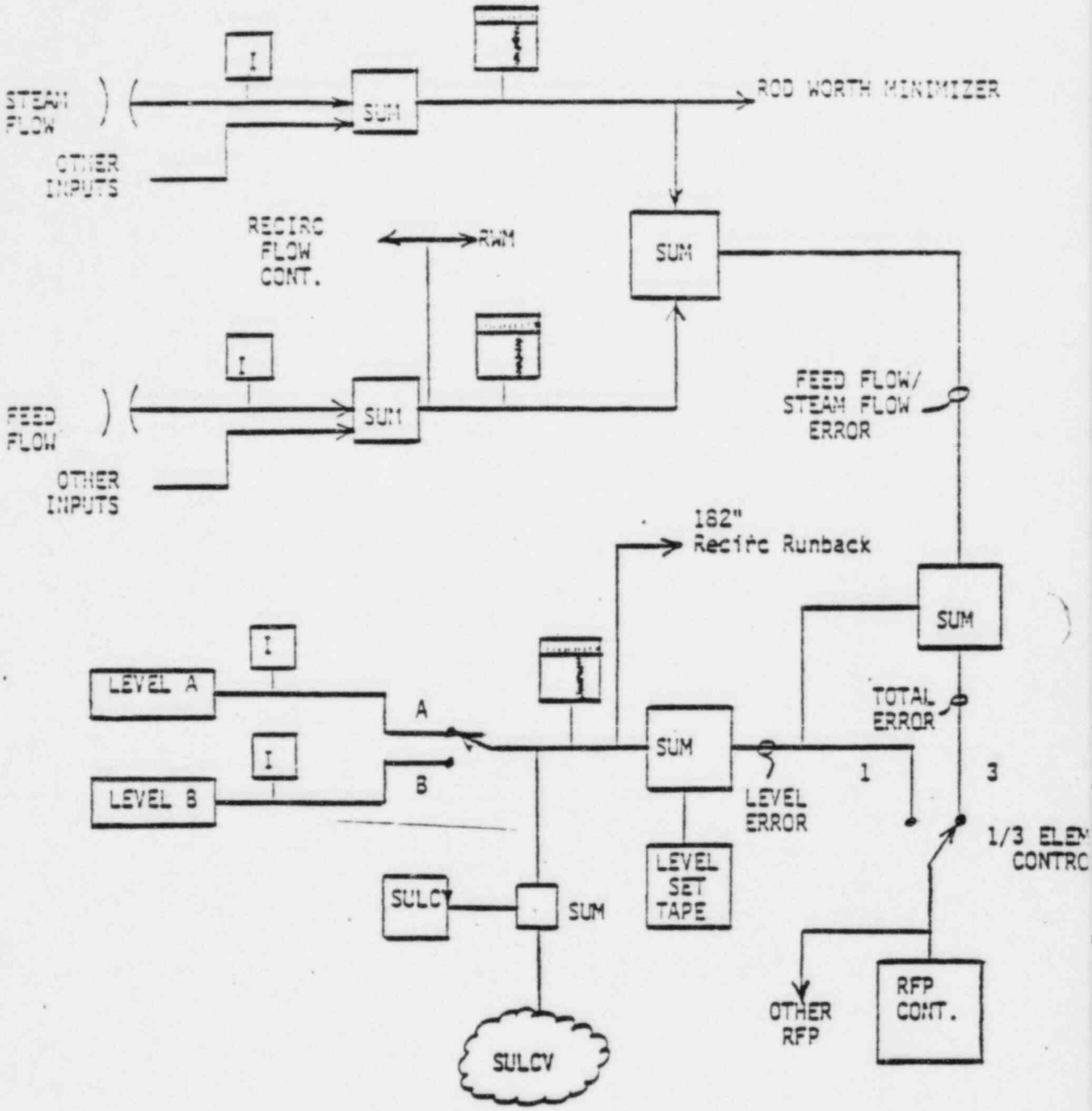


Figure 32.2-5
Feedwater Level Control

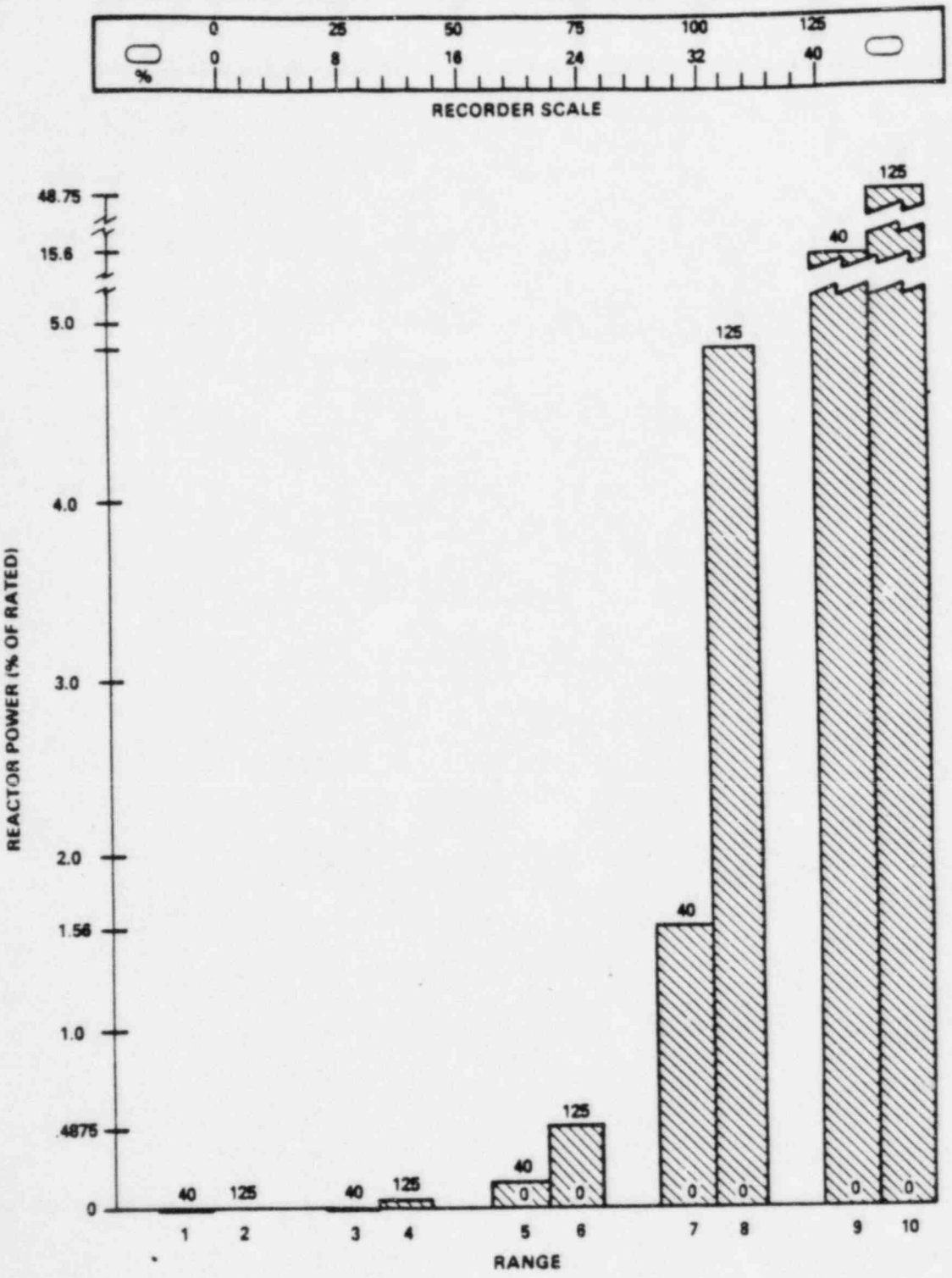
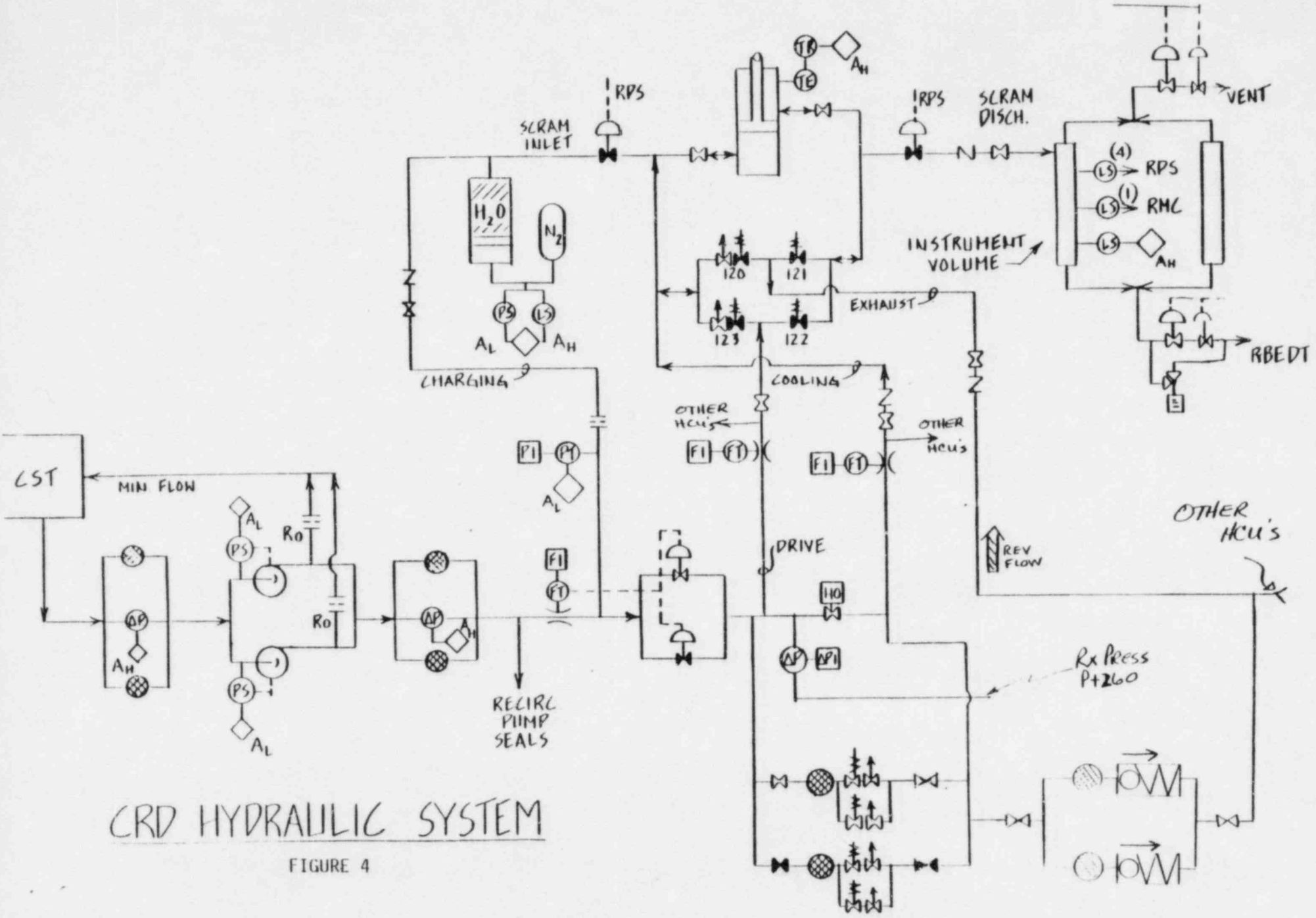


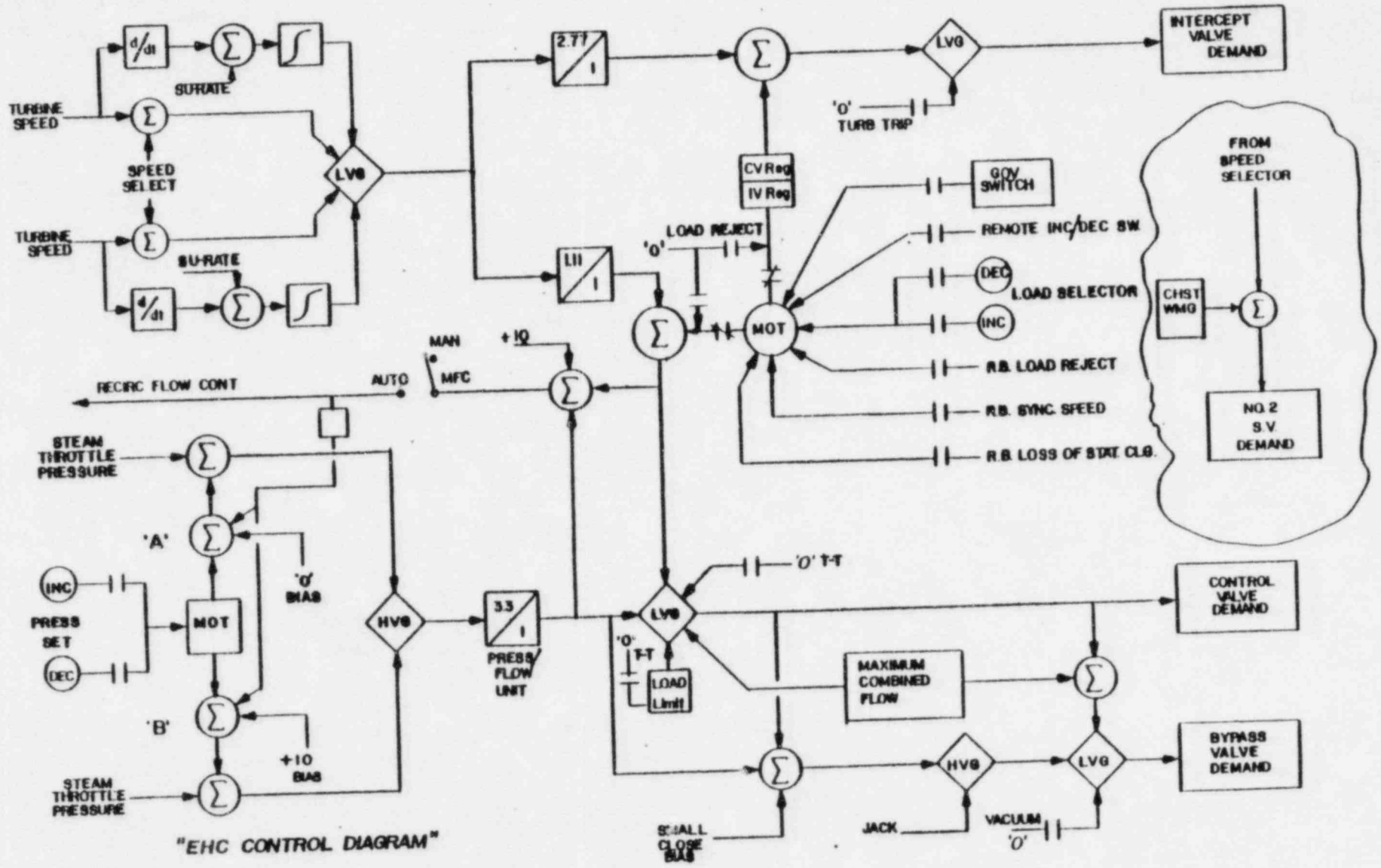
Figure 5.2-4 IRM Range and Scale Relationships.



CRD HYDRAULIC SYSTEM

FIGURE 4

APPENDIX



"EHC CONTROL DIAGRAM"

FIGURE 2

PRESSURE REGULATION: (cont'd)

(FIG. 1)

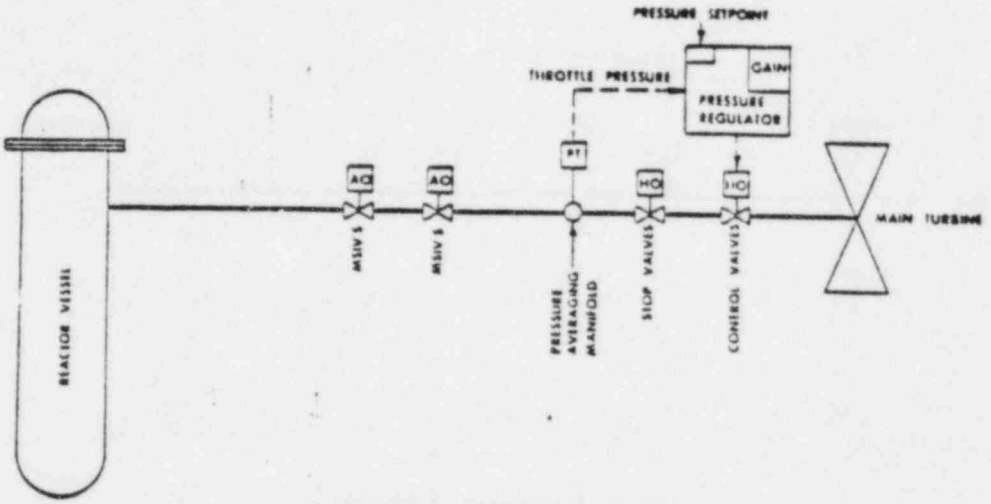


Figure 1. Pressure Regulator

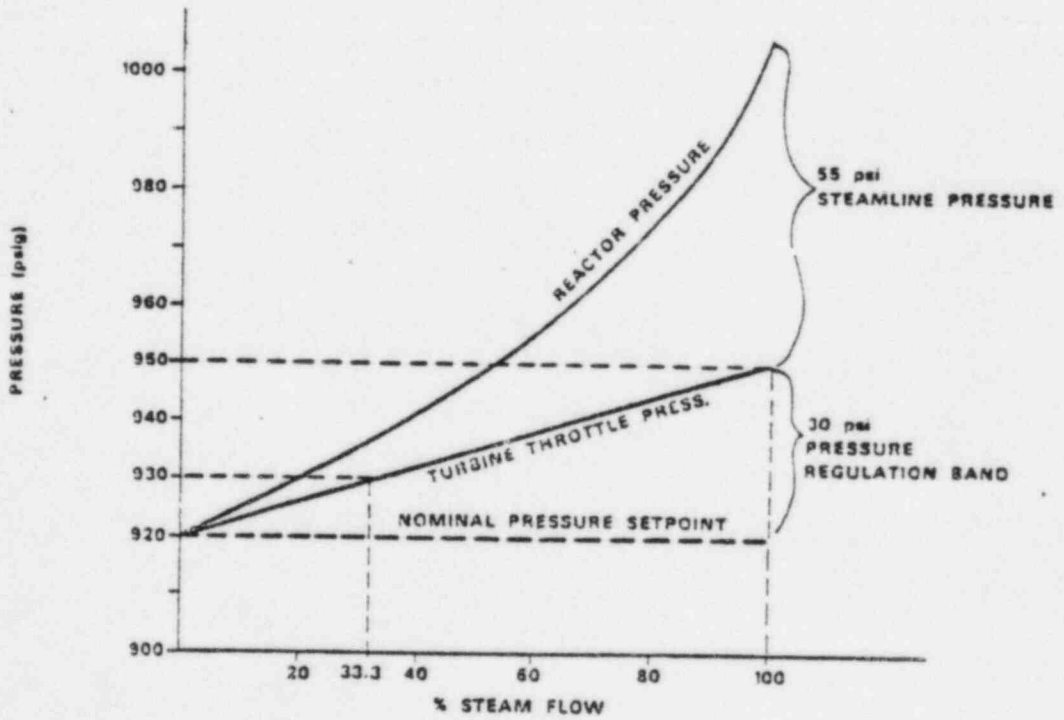
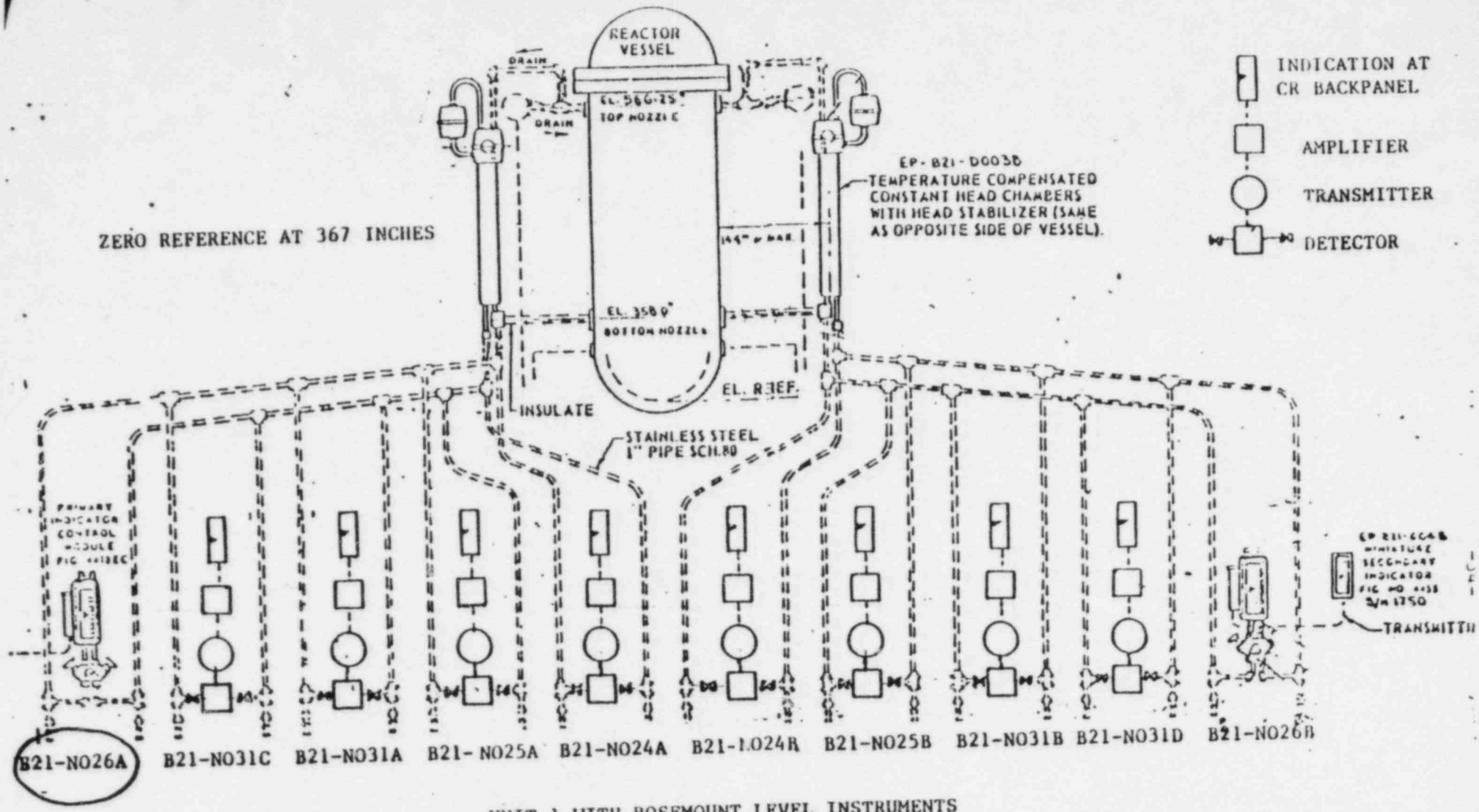


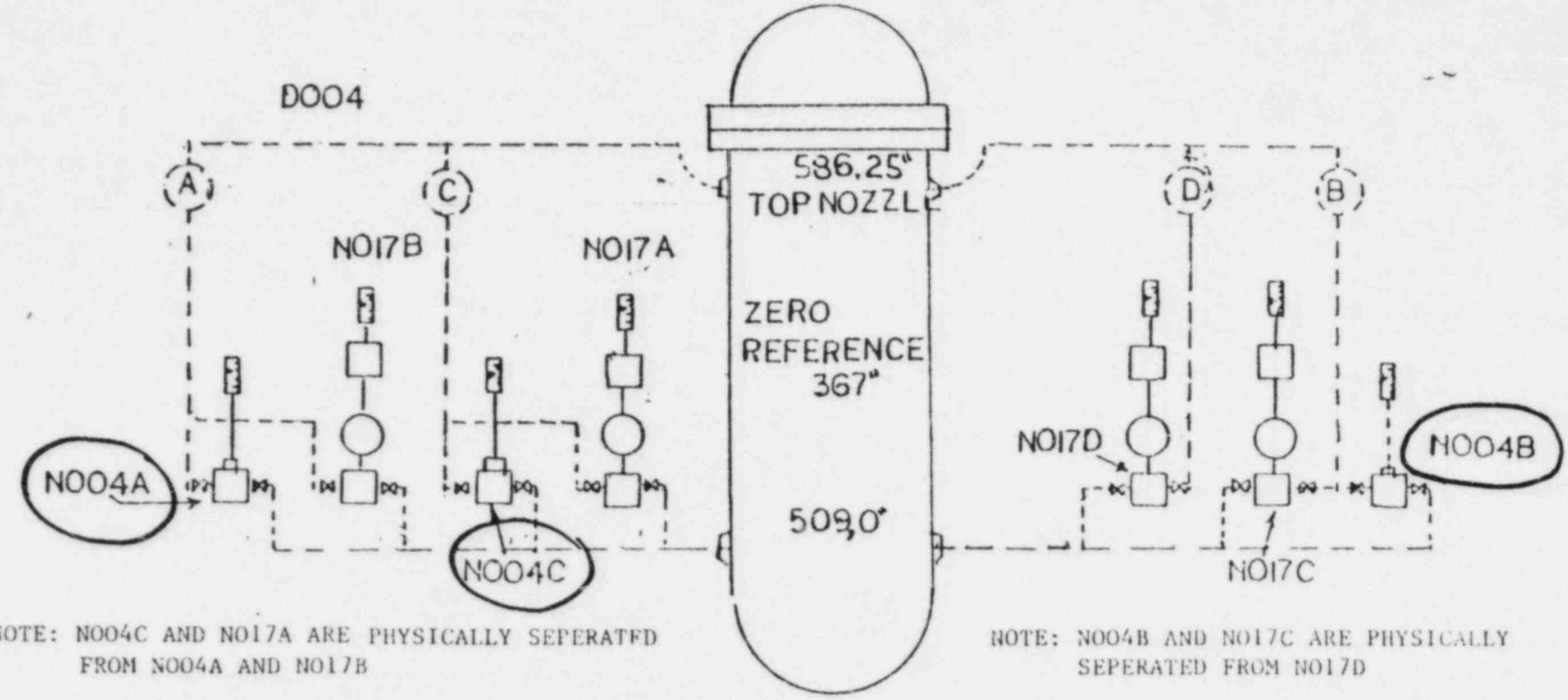
Figure 3 Pressure-Steam Flow Relationship



UNIT 1 WITH ROSEMOUNT LEVEL INSTRUMENTS

FIGURE 12

ROSEMOUNT AND GEMAC LEVEL INSTRUMENTS



NOTE: N004C AND N017A ARE PHYSICALLY SEPERATED FROM N004A AND N017B

NOTE: N004B AND N017C ARE PHYSICALLY SEPERATED FROM N017D

UNIT 1 AND UNIT 2 ARE ALIKE EXCEPT THAT

UNIT 2 HAS BARTON DIFFERENTIAL INSTRUMENTS.

FIGURE 10

ANSWER SHEET for Question 3.06

1. C32-N004A will indicate _____ (rising, lowering, or no change) in water level

2. FWLCS response - _____

   _____

3. Actual Vessel Level is _____ (increasing, decreasing, or not changing)

4. RPS response - _____

   _____

5. Level Indicating (indication is proper or improper)

   C32-N004C - _____

   C32-N004B - _____

   B21-N026A - _____

ANSWER SHEET for Question 3-10

INITIAL RESPONSE:

a. TCV position _____ (in % steam flow demand)

b. BPV position _____ (in % steam flow demand)

c. Power _____ } (increase, decrease, or remain the same)

d. Pressure _____ }

Reason: _____

_____

_____

FINAL STATUS:

a. TCV position _____ (in % steam flow demand)

b. BPV position _____ (in % steam flow demand)

c. Power _____ } (nigher than, lower than, or the same as the initial value)

d. Pressure _____ }

Reason: _____

_____

_____

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVANME, J.

ANSWER 1.01 (2.75)

A. BOL U-235 93% EOL U-235 56%
U-238 7% (.75) U-238 7%
Pu-239 37% (.75) (1.5)

B. A (.25)

C. ~~3~~ (.20 each) 3-True 4-True (1.0)
1- False
2- False

REFERENCE
RX THEORY SECT 1- PG 16,14,9

ANSWER 1.02 (4.00)

Failure-- Bypass valves fail to open (1.0)
a. Vessel Level- decreases due to void collapse caused by the stop valve closure and scram. (.75)
b. APRM- sharply drops because of the anticipatory scram. (.75)
c. Vessel Level- caused by voiding and void collapse as the SRV's control pressure around 1100 psia. (.75)
d. Total Steam Flow- Turbine steam flow goes to zero as stop valves close on the turbine trip. Total steam flow goes to near zero as the bypass valves fail to open. (.75)

REFERENCE
BUR-1 TRANSIENTS

ANSWER 1.03 (1.75)

reactivity of voids=(-1x10E-3 dK/K/%V)(1.5%V)
= -1.5x10E-3 dK/K (.75)

reactivity of doppler=(-1x10E-5 dK/K/F)(40 F)
= -.4x10E-3 dK/K (.75)

Rod worth= -.4 + -1.0= -1.9x10E-3 dK/K (.25)

REFERENCE
RX THEORY II- PG 8-13

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVANME, J.

ANSWER 1.04 (2.00)

a. Decreases [0.25]. There is less steam flow, therefore less pressure drop through the main steam lines [0.75]. (1.0)

b. Increases [0.25]. With the same amount of cooling water through the condenser and less of a heat load, condensate depression will increase [0.75]. (1.0)

REFERENCE
BSM CONDENSATE AND FEEDWATER
BSM MAIN STEAM AND EHC

ANSWER 1.05 (2.00)

Power at setpoint= (118%)(2436 MW)= 2874 MW (.5)

Peak Power= (2874MW) e^(t/T) = 2874 e^(10sec/10sec) = 2874 e (1.0)

=7,813.6MW or 7.81GW (.5)

REFERENCE
BRUNSWICK RX THEORY, II- PG 39

ANSWER 1.06 (3.00)

a.- Power, Local Power, Flow, or Local Flux
- Flow
- Pressure
- Inlet coolant temperature
(3 of 4 req. @ 0.333 each) (1.0)

b. 1. MAPRAT is the ratio of APLHGR(act) to MAPLHGR(LCO).[0.75]
2. NO [0.5]
3. The clad temperature can exceed 2200 deg. F during a DBA LOCA.[0.75] (2.0)

REFERENCE
BRUNSWICK THERMAL LIMITS

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVANME, J.

ANSWER 1.07 (2.00)

The reactor is now producing less steam to go to the turbine. There will be less extraction steam and heater drain steam going to the feedwater heater.(1.0) Therefore less feedwater heating will occur resulting in colder feedwater entering the vessel(.5) which will cause reactor power to increase until a positive reactivity addition (approx 1%).(.5) (2.0)

REFERENCE
P&ID Extraction Steam & RXTH II- PG 8

ANSWER 1.08 (2.00)

With the reactor shutdown by 1% as measured at the time of peak Xenon, the Shutdown Margin will decrease as Xenon decays. Since peak Xenon reactivity is greater than 1% dK/K, a reactor restart would occur as peak Xenon decays in the next 20 hours.

REFERENCE
RX THEORY II- PG 16,28

ANSWER 1.09 (1.00)

1. Decreased cooling water flow
2. Increased cooling water temperature
3. Fouling of condenser tubes
4. Air leakage/buildup in the condenser
5. Air in the water box
6. Flooded hotwell

(4 required at .25 each) (1.0)

REFERENCE
HTX & FF L.P.
APP UA-23 2-1, pg 1

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVANNE, J.

ANSWER 1.10 (2.00)

A. Cavitation is the process of forming and collapsing bubbles in a system. At some point the pressure is lowered enough to form vapor pockets (boiling). At some other point in the system the pressure will be high enough to collapse the voids. (1.0)

B. 1. Height of the column of water above the pump suction
2. Fluid subcooling (pressure)
3. Irreversible flow losses in the suction line (friction)
(.5 each) (1.0)

REFERENCE
GE THERMO, HTX, & FF
RX RECIRC SYS STUDY GUIDE, REV 0, PG 17

ANSWER 1.11 (2.00)

A. Void coef. (.5) Decreased pressure caused by the SRV opening causes an increase in voids (.25), and adds negative reactivity.(.25)

B. Fuel temp. coef. (.5) The rapid addition of positive reactivity due to the rod drop (removal) causes power to increase therefore fuel temperature increases (.25) adding negative reactivity.(.25)

(1.0 each)

REFERENCE
SSM, RX THEORY II, PG 11-14

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAMME, J.

ANSWER 2.01 (3.00)

a. Water flows from:
Fuel pool to (skimmer surge tanks, out of skimmer surge tanks - through) spool piece to RHR common suction line - RHR pump - RHR HTX - through spool piece - back to fuel pool through diffuser. (1.0)

b. 1. There are no connections to spent fuel pool which would allow the pool to be drained below the pool gate between the fuel and reactor well. (.75)
2. Each spent fuel pool diffuser line is fitted with a vacuum breaker valve. This prevents draining through siphoning action. (.75)

REFERENCE
SSM BOOK 1, FUEL POOL COOLING & C/U, PG 1 & FIG 1

ANSWER 2.02 (3.00)

CRD accumulator pressure (0.5)
Vessel water (0.5)

a. At low reactor pressure, the vessel has no effect and scram is accomplished only by the accumulator. (.66)

b. (As the vessel pressure rises, the accumulator is pressured on the upper end of the stroke.) As water is forced from the accumulator, accumulator pressure falls below reactor pressure and causes the ball check valve to open allowing reactor pressure to complete the scram. (.66)

ALTHOUGH IT STILL GIVES THE CRD ITS INITIAL BOOST.

c. By 1000#, the accumulator is not necessary and reactor pressure will provide enough hydraulic pressure to meet scram insertion times. (.67)

REFERENCE
SSM BOOK 1, CRD DRIVES, PG 14
CRD SD-08 JTA

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVANNE, J.

ANSWER 2.03 (3.00)

A. 1. Main Turbine Lube Oil Cooler
2. EHC Oil Coolers
3. RFP Turbine Oil Coolers
4. Recirc MG Oil Coolers (.5 each) (2.0)

B. They have variable heat loads for which a constant temperature must be maintained throughout the entire load range. (1.0)

REFERENCE
SSM BOOK 3, TBCCW, PG 3

ANSWER 2.04 (4.00)

A. RHR- 1.Shutdown cooling mode- provides decay heat removal capability. Takes a suction from recirc pump A suction line and returns to either recirc pump discharge line. (1.0)
2.LPCI mode- provides flooding of the core at lower pressures to maintain the core covered on a LOCA by discharging to both recirc pump discharge lines. (1.0)

B. RWCU inlet is taken off the RHR suction off of 'A' recirc loop. (.5)

C. RBCCW provides cooling to recirc pump motor coolers and seal cavity coolers. (1.0)

D. CRD Hydraulics provides seal purge water to the recirc pump mechanical seal assemblies. (.5)

REFERENCE
SS4 BOOK 3, RECIRC SYSTEM, PG 11

ANSWER 2.05 (3.00)

A. Condenser vacuum would decrease(.5) due to the air ejectors tripping(.5) (1.0)

B. Reactor feed pump controls lockup(.5) due to loss of RFP control signal.(.5) (1.0)

C. No effect(.5) The EHC system has a permanent magnetic generator on the Turbine which would continue to provide power(.5) (1.0)

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAMME, J.

REFERENCE
UPS STUDY GUIDE PG 6
MOD-PM-81-2188

ANSWER 2.06 (3.00)

A. A void space may develop in the RWCU system. ALSO ACCEPTED: FLASHING (1.0)
DEPRESSURIZING & WATER HAMMER in RWCU w/ REJECT VALVE CYCLING due to 5# pressure trip

B. Venting the pump seals on a running RWCU pump may result in the failure of the pump seals. (1.0)

C. During power reject operations, both reject valves to radwaste and the condenser must not be opened simultaneously while there is a vacuum in the condenser or it can be lost via radwaste. (1.0)

REFERENCE
UNIT 2 OP-14, REV 45, PG 10,9

ANSWER 2.07 (2.50)

NRV's are used to prevent overspeeding of the turbine due to flash-back of the condensate in the feedwater heaters after a turbine trip.(.75) (Each NRV is composed of a closing spring and a double action pneumatic cylinder actuated by solenoid valves.) During normal operation, the NRV is held open by instument air.(.75) On a turbine trip, (the Turbine Trip Air Relay Dump Valve which is normally held open by EHC oil pressure is released and the IA supply to the NRV is vented to atmosphere) shutting the NRV.(1.0) (2.5)

REFERENCE
EXTRACTION STEAM SD, REV 1, PG 4,5

ANSWER 2.08 (1.50)

Reactor pressure less than or equal to 135 psig OR 140psig.
Drywell pressure < 2 psig
Reactor level > 162 1/2 inches (.5 each) (1.5)

REFERENCE
RHR Study Guide pg 7

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAANME, J.

ANSWER 2.09 (2.00)

A. When control for the D/G is selected to Control Room Manual the diesel may not be on to the Emergency bus on loss of offsite power. Due to this, the D/G must be declared inop. (1.0)

B. The D/G trip on reverse power causes a D/G lockout which would make the D/G unavailable for auto emergency operation until the trip and reset were manually reset. (1.0)

REFERENCE
CP&L Study Guide: Emergency Diesel Generators
CP&L LER 1-82-73 and LER 2-82-124

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAHME, J.

ANSWER 3.01 (3.00)

A. Yes the system will initiate(.5) On the initiation signal, F-010 (RCIC suction from the CST) will auto open. F-029 & F-031 will remain closed.(1.0) (1.5)

B. 1. T
2. T
3. F (.25) set point is 120% (.25) (1.5)

REFERENCE
BSM BOOK 3, RCIC, PG 8
BSM, RCIC, PG 3

ANSWER 3.02 (2.00)

1. Direct scram
2. Closure of MSL drain isolation valves
3. MSIV closure
4. Closure of Rx water sample valves (.5 each) (2.0)

REFERENCE
SD-20, Main Steam System, Rev 6, PG 23
SD-12, Containment Isolation, Rev 6, PG 2
BSM BOOK 3, RPS, Rev 1, PG 9

ANSWER 3.03 (2.50)

A. compensated (.5)
B. Wide Range or 0°-210° or Instrument No. 26 A & B (.5)
C. ~ 8.44 inches (will accept + or - one inch) (.5)
D. Indicated level in the annulus, is greater than actual level(.5) due to the pressure drop across the steam drains components(.5). (1.0)

REFERENCE
Reactor Vessel Level Instruments PG 5,6,41,46
Training Plant Mod 80-130/131 Vessel Reference Change PG 1-2

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVARNE, J.

ANSWER 3.04 (2.00)

No (.5) When transferring RPS power supplies, the RPS is momentarily deenergized because the transfer is break before make. This would result in a scram due to the 1/2 scram already present.(1.5) (2.0)

REFERENCE
SD-9,APRM, pg 4

ANSWER 3.05 (3.50)

A. 1. High DW pressure (1.8 psi)
2. Low vessel level (+118 inches)
3. High radiation in Rx Bldg ventilation (10mr/hr)
(.5 for signal,.16 for setpoint) (2.0)

B. T
F
F (.5 each) (1.5)

REFERENCE
Unit 2, OP-10, Rev 21, pg 10,11
SSM BOOK 3, SSOT, pg 5

ANSWER 3.06 (2.50)

1. Level channel A will indicate rising water level(.5)
2. FWLCS will slow the RFP's to try to maintain level(.5)
3. Actual vessel level is decreasing(.5)
4. Reactor will scram on low level(.5)
5. N004C- indicates properly, N004B- indicates properly
N0026A- indicates properly (.5) (2.5)

REFERENCE
SD-32-2, FWCS
SSM BOOK 3, Vessel Level Inst, pg 8,9

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAMME, J.

ANSWER 3.07 (1.00)

A. 1. APRM 4. Core Flow (Recirc)
2. LPRM 5. Steam/Feed Flow
3. RNCS (.33 each)

B. TRUE (.3)

REFERENCE
GSM BOOK 3, RBM, REV 0, PG 2,11,12

ANSWER 3.08 (3.00)

A. New reading on range 7 is 2.5 (.5)
no auto actions (1.0)

B. New reading on range 5 is 39 (.5)
IRM high rod block and HI-HI half scram will be in. (1.0)

REFERENCE
SD-09-1, Neutron Monitoring, Rev 004, PG 1,2

ANSWER 3.09 (2.50)

A. event 4 (0.5)

5.1. upward 6. 0.64
2. energizes 7. deenergizes
3. deenergizes 8. energizes
4. closes 9. opens
5. UP 10. 8.5 (0.2 each) (2.0)

REFERENCE
SD-7,RNCS, REV 2, PG 7,19

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAHNE, J.

ANSWER 3.10 (2.50)

INITIAL RESPONSE:

A. TCVs- ~~no te~~ 100%^open (steam flow position JPM)
B. BPVs- open to 10 %
C. Power- decreases
D. Pressure- decreases

REASON: Above caused by FCV calling for 110% steam flow ((PDO-P15)X 3.3) and limited by MCF limit of 110%. CAF (1.25)

FINAL STATUS:

A. TCVs- at 100%^open position (steam flow JPM)
B. BPVs- shut
C. Power- slightly lower
D. Pressure- slightly lower

REASON: above caused by the decrease in Pressure and Power causing BPVs to shut-- FCV cycling to new equilibrium state ((940-915) X 3.3) (1.25)

REFERENCE
Brunswick Retraining Lesson Plan EHC Study Guide
Brunswick Regual Exam Question

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVARNE, J.

ANSWER 4.01 (2.75)

A. trends (.5)
consistency (.5) (1.0)

B. When it is determined that an annunciator will cause a significant distraction to the Control Operator (.75) and it is not feasible to change plant conditions (.5) nor is it desirable to disable the annunciator (.5) (1.75)

REFERENCE
OI-01 VOL VII, REV 4, PG 1
OI-05 VOL VII, REV 4, PG 3

ANSWER 4.02 (3.50)

A. Coupling integrity is checked anytime a control rod is fully withdrawn (.75) by verifying the rod does not reach the over-travel position. (.75) (1.5)

B. 1-b
2-d
3-e
4-e (.5 each) (2.0)

REFERENCE
GP-02, REV 1, PG 11, 14, 18, 19

ANSWER 4.03 (2.50)

A. Min = 60%, Max = 75% (1.0)

B. ~~The >B> pump MG Set Drive Motor Breaker will trip. (1.0) if bypass valve shut.~~
~~To prevent axial thrusts on the pump.(.5)~~ (1.5)
DM
OE
Recirc pump will runback to 28% as the #1 limiter is picked on discharge valve going shut. (1.0) To prevent axial thrusts on pump & OE overheating (.5)

REFERENCE
CP&L STUDY GUIDE; RECIRCULATION SYSTEM
CP&L OPERATING PROCEDURE; OP-02

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVARNIE, J.

ANSWER 4.04 (3.00)

1. Turbine shell to rotor differential expansion indicating in the red band.
2. Turbine Journal bearing high vibrations ~~near the critical speed or any other speed~~ Per Procedure at Spec: Fld
3. High journal bearing metal temperatures.
4. High thrust bearing metal temperatures.
5. High differential temp between bearing inlet oil and bearing drain oil temp.

(4 required @ .75 each) (3.0)

ALSO ACCEPTABLE
6. LOSS OF SPEED CONTROL OF TURBINE.

REFERENCE
GP-03, REV 1, PG 10, 16

ANSWER 4.05 (4.00)

a. RC/L - Maintain adequate core cooling OR Rx level control. (0.5)

RC/P - Control RPV pressure and cooldown the RPV to cold shutdown conditions if warranted OR Rx pressure control. (0.5)

RC/Q - Shutdown the reactor OR Rx power control. (0.5)

b. 1. RPV water level ~~below Elev ft~~ above +112 in. (0.5)
2. ~~RPV pressure above 1045 psig~~ Any Rx Pwr Avn Mode From SAT (0.5)
3. Drywell pressure above 2.0 psig. (0.5)
4. ~~A condition which requires an MSIV isolation~~ Mode Sw in Run Prot Scram (0.5)
5. ~~A condition which requires a reactor scram~~ reactor power remains above 3% (OR cannot be determined). (0.5)

REFERENCE
BRUNSWICK EOP-01-UG; PG 31, 32, 21

ANSWERS -- BRUNSWICK 1&2 -84/11/13-KVAMME, J.

ANSWER 4.06 (3.00)

1. RWCU: Use a submersible pump to transfer SLC tank to the RWCU precoat tank which is used to fill a F/D.
2. RCIC: Connect a hose (stored in LEP toolbox) between RCIC suction at CST vent valve and SLC tank drain.
3. HPCI: Connect a hose (stored in LEP toolbox) between HPCI suction at CST vent valve and SLC tank drain.
4. CRD: Connect hose to CRD suction vent and SLC tank drain.
(2 required, 1.5 each) (3.0)

REFERENCE
EOP-1, LEP- Alternate Boron Injection, Rev 0

ANSWER 4.07 (3.00)

A. 1. Depressurization of the Reactor is required AND
2. Less than three SRV's can be opened AND
3. Reactor pressure is at least 50 psid > suppression chamber pressure.
(.5 each) (1.5)

B. Yes the condenser can be used to depressurize.(.5) Four jumpers are installed to reset the Group 1 isolation. Pressure can then be equalized around the MSIV's and opened.(1.0) (1.5)

REFERENCE
EOP-01-EDP, pg 3,4

ANSWER 4.08 (3.25)

A. 1. Manually scram the reactor(.5) and verify all rods fully inserted.(.5) (1.0)
2. Manually trip the turbine generator. (.5)
3. Close all MSIV's. (.5)

B. 1. Go to the battery room.(.25)
2. Open RPS MG output breaker.(.5)
3. Place alternate feed switch (LO3) to the off position.(.5) (1.25)

REFERENCE
AOP-32, Plant S/D Outside The Control Room, Rev 0, pg 3

QUESTION	VALUE	REFERENCE
01.01	2.75	TLM0000105
01.02	4.00	TLM0000106
01.03	1.75	TLM0000107
01.04	2.00	TLM0000108
01.05	2.00	TLM0000109
01.06	3.00	TLM0000110
01.07	2.00	TLM0000111
01.08	2.00	TLM0000112
01.09	1.00	TLM0000113
01.10	2.50	TLM0000114
01.11	2.00	TLM0000132
	25.00	
02.01	3.00	TLM0000096
02.02	3.00	TLM0000097
02.03	3.00	TLM0000098
02.04	4.00	TLM0000099
02.05	3.00	TLM0000101
02.06	3.00	TLM0000102
02.07	2.50	TLM0000104
02.08	1.50	TLM0000135
02.09	2.00	TLM0000136
	25.00	
03.01	3.00	TLM0000100
03.02	2.00	TLM0000124
03.03	2.50	TLM0000125
03.04	2.00	TLM0000126
03.05	3.50	TLM0000127
03.06	2.50	TLM0000128
03.07	1.50	TLM0000130
03.08	3.00	TLM0000131
03.09	2.50	TLM0000133
03.10	2.50	TLM0000134
	25.00	
04.01	2.75	TLM0000115
04.02	3.50	TLM0000116
04.03	2.50	TLM0000117
04.04	3.00	TLM0000118
04.05	4.00	TLM0000119
04.06	3.00	TLM0000120
04.07	3.00	TLM0000121
04.08	3.25	TLM0000122
	25.00	
	100.00	

Enclosure 3
(2 of 2)

TABLE ES-403-1

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

Facility: BRUNSWICK
Reactor Type: BWR-4
Date Administered: NOV.12,1934
Examiner: S. GUENTHER
Candidate: _____

INSTRUCTIONS TO CANDIDATE:

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

Category Value	% of Total	Candidate's Score	% of Category Value		Category
25.0	25.4			5.	Theory of Nuclear Power Plant Operation, Fluids, and Thermodynamics
25.5	25.9			6.	Plant Systems Design, Control, and Instrumentation
24.0	24.4			7.	Procedures - Normal, Abnormal, Emergency, and Radiological Control
24.0	24.4			8.	Administrative Procedures, Conditions, and Limitations
98.5					Totals

Final Grade

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

_____
Candidate's Signature

5.0 Theory Nuclear Power Plant Operation, Fluids and Thermodynamics

5.1. Which one of the following statements is NOT true regarding the LHGR (Linear Heat Generation Rate) thermal limit? (1.0)

(a) The LHGR design limit = 13.4 kw/ft for 8x8 fuel.

(b) The limit is based on maintaining peak cladding temperature $\leq$ 2200°F.

(c) The safety limit decreases with fuel exposure.

(d) If the limit is exceeded, it could result in fuel clad cracking due to high stress.

5.2 Which of the following is NOT a true statement concerning Xenon poisoning? (1.0)

(a) The concentration will build up and insert negative reactivity immediately following a reactor trip.

(b) Equilibrium Xenon is reached sooner at high power levels due to a faster production rate.

(c) The time after a reactor trip that Xenon peaks is independent of neutron flux before the trip.

(d) Equilibrium Xenon reactivity worth at 50% power is NOT half of the equilibrium Xenon reactivity worth at 100% power.

5.3 The moderator temperature coefficient... (1.0)

(a) ...becomes less negative over core life due to the increase in core size with lower rod density.

(b) ...has a negative reactivity effect due to an increase in the nonleakage probability and resonance escape probability with increased moderator temperature.

(c) ...has a BOL value of approximately -1×10^{-5} $\Delta k/k/°F$.

(d) ...has a smaller negative effect at higher moderator temperature than at lower moderator temperature.

5.4 Which of the following statements is true regarding intrinsic neutron sources in a shutdown reactor? (1.0)

(a) Practically all the source neutrons from spontaneous fission come from U-235.

(b) The alpha-neutron source comes from the alpha decay of U-238, U-239, and Plutonium which interact with Oxygen-18 in the moderator to yield neon and a neutron.

(c) The major concentration of source neutrons comes from spontaneous fission.

(d) The photo-neutron source is NOT significant at BOL due to low D_2O concentration and low gamma field.

5.5 Which of the following statements is NOT true regarding the effects of core aging? (1.0)

(a) Resonance escape probability decreases from BOL to EOL due to the build up of Pu-239/240.

(b) The addition of equal amounts of positive reactivity will result in a shorter period at EOL due to the decrease in B-eff.

(c) The fuel temperature coefficient (Doppler) becomes less negative at EOL due to the increased resonance absorption during neutron thermalization.

(d) Core excess reactivity is greatest at MOL due to the burnable poison depleting at a faster rate than the fuel.

5.6 The condensate subcooling in a condenser operating at 1 psia with a condensate temperature of 95°F is approximately: (1.0)

(a) 6.7°F

(b) 196°F

(c) 1.07°F

(d) 25.3°F

5.7 If a centrifugal pump is operating at 1800 rpm to give 400 gal/min at a discharge head of 20 psi, what would be the discharge head if the speed is increased in order ~~the~~ to deliver 800 gpm? (1.0)

(a) 40 psi

(b) 60 psi

(c) 80 psi

(d) 160 psi

5.8 (a) Attached figure 5.8 illustrates two yarway level detectors, A and B.

1. Which detector, A or B, is temperature compensated? (0.5)

2. In the event of a rapid reactor depressurization, which detector, A or B, would remain accurate to a lower reactor pressure? (0.5)

(b) The fuel zone level indicator cannot be used as a precise indication of level inside the shroud during LPCI operation. Would indicated level be above or below actual level? Briefly justify your answer. (1.0)

5.9 Briefly describe the two natural circulation flow paths/loops present in a BWR reactor vessel AND the driving force for each path. (2.0)

5.10 Attached figure 15.2.3-4 from the BSEP FSAR illustrates selected plant parameter changes resulting from a Unit 2-Cycle 5 closure of all MSIVs with a high neutron flux scram. The transient is initiated from 105% power with no operator action. Answer the following questions with regard to the graphs on the attached figure. Graphs other than those referred to by question may be required to make a proper interpretation.

a. On graph A, what is causing neutron flux (line 1) to spike between 1.6 and 3.2 seconds? (0.5)

b. Also on graph A, what causes core inlet flow (line 3) to decrease after about 3 seconds? (0.5)

c. On graph C, what is causing vessel steam flow (line 2) to increase rapidly at about 2.8 seconds? (0.5)

d. Also on graph C, why is vessel level (line 1) increasing beyond 4.8 seconds? (0.5)

e. If all the normal RPS trips had been functioning properly, then neutron flux would have peaked much lower (about 133%) than it did (>>150%). Briefly explain why the flux peak should and would have been lower. (1.0)

5.11 Consider the attached process computer "Periodic NSS Core Performance Log" (figure 5.11).

(a) What is the actual reading (% Power) on APRM "3" (Show calculations.) (1.0)

(b) Assuming a required MCPR (CPRLIM) of 1.30, what is the actual CPR for core region 6 (bundle 41-34)? (1.0)

(c) Draw a sketch of the relative axial neutron flux shape based upon the attached performance log. (1.0)

5.12 The BSEP containment atmospheres are innerted with nitrogen to limit initial oxygen content.

(a) What is the principal source of oxygen in containment following a LOCA? (0.5)

(b) What is the principal source of hydrogen in containment following a LOCA? (0.5)

(c) What are the maximum permissible concentrations of hydrogen and oxygen (in volume percent) in containment following a LOCA? (0.5)

5.13 Answer the following questions with regard to General Electric's Preconditioning Interim Operating Management Recommendations (PCIOMR):

(a) What is the purpose of the twelve hour soak period at the final power level (power increase has stopped)? (0.5)

(b) Starting with the fuel at a threshold of 11.0 kw/ft, a maximum ramp increase is begun at time 0000 and the final desired power of 13.0 kw/ft is achieved at 2000. The required soak is performed until 0300, at which time the load dispatcher directs a power reduction that takes nodal power down to 12.0 kw/ft. What is the valid preconditioned value for this node, and how would power be returned to 13.0 kw/ft? Assume an allowable nodal power increase rate of 0.10 kw/ft/hr. (1.0)

(c) Once the fuel has been preconditioned, operation within the operating "envelope" is relatively unrestricted. What range of power is referred to as the operating "envelope"? (1.0)

5.14 The Standby Liquid Control System (SLC) injects a sodium pentaborate solution of 13.4 weight precent into the reactor coolant at a rate of from 6 to 25 ppm per minute. Why (i.e., what is the basis) is there a minimum rate (6ppm/min) at which the solution must be injected? (1.0)

5.15 (a) What is the major benefit derived from the Feedwater Heating System at BSEP? (0.5)

(b) Which one of the graphs on figure 5.15 (attached) best illustrates the temperature relationships in a parallel flow heat exchanger? (0.5)

5.16 Answer the following with respect to the theory of nuclear instrumentation operation:

(a) During an LPRM's lifetime, its sensitivity to neutrons will decrease but its sensitivity to gammas will remain unchanged. Briefly explain WHY. (1.0)

(b) The SRMs use a pulse height discriminator to filter out gamma pulses so only neutrons are counted. What are the two (2) sources of these gamma pulses? (1.0)

WRITE "END OF CATEGORY 5"
ON YOUR ANSWER SHEET
AND START NEW PAGE

6.0 Plant Systems Design, Control, and Instrumentation

6.1 Which of the following statements is true regarding a BWR reactor core? (1.0)

(a) All fuel assemblies in the core receive their vertical support from the control rod guide tubes.

(b) Peripheral fuel assemblies are supported by the lower core grid.

(c) All fuel assemblies in the core receive their vertical support from the lower core grid.

(d) The lower core grid is supported by the control rod guide tubes.

6.2 A set of ten vacuum relief valves are located on the TORUS ring header, with a direct flow path into the DRYWELL. These valves... (1.0)

(a) ... prevent the TORUS from exceeding its maximum design vacuum of -2 psig.

(b) ... completely open within one second after drywell pressure exceeds TORUS pressure by 0.5 psid.

(c) ... prevent the backflow of TORUS water into the DRYWELL when Containment Spray is activated after a LOCA.

(d) ... are manually testable using local lever arms.

6.3 Which of the following statements is true concerning the Reactor Manual Control System (RMCS)? (1.0)

(a) A timer malfunction circuit monitors the operation of the automatic sequence timer during the rod insert and withdraw modes.

(b) A "Rod Drift" alarm will be actuated any time a selected rod is driven to the "overtravel" position.

(c) When the "RONOR" switch is kept in the "Emergency Rod In" position it will bypass all rod insert blocks.

(d) A Rod Block annunciator will be present any time the white "Rod Withdraw Permissive" light is extinguished.

6.4 Selected ARM sensor and converter units have installed "bug sources". These sources ... (1.0)

(a) ... are normally shielded and are exposed only as required to test the detector's operation.

(b) ... are only installed on those sensors requiring an auxiliary trip unit.

(c) ... do not affect the ARM's indicated background radiation level in those areas monitored.

(d) ... aid in the detection of equipment malfunctions which cause downscale trips.

6.5 Unit 2 is in STARTUP at 5% power. Which one of the following signals will result in a Group I isolation? (1.0)

(a) Main Steam Line Flow High

(b) Drywell Pressure High

(c) Condenser Vacuum Low

(d) Main Steam Line Turbine Inlet Pressure Low

6.6 The RCIC (Reactor Core Isolation Cooling) System is capable of taking a suction from the CST or the suppression pool. The suppression pool suction valves (F031 and F029) and CST suction valve (F010) are interlocked such that ... (1.0)

(a) ... the suction will automatically transfer from the CST to the suppression pool on high suppression pool water level.

(b) ... the CST suction valve will automatically open if the suppression pool suction valves are manually closed while in standby mode.

(c) ... the CST suction valve will automatically close if the suppression pool suction valves are opened.

(d) ... the CST suction valve and both suppression pool suction valves will automatically close on a Group V (RCIC) isolation signal.

6.7 Four 25% capacity centrifugal pumps per unit are used to discharge the circulating water effluent (ultimately) into the Atlantic Ocean. These pumps... (1.0)

(a) ... will automatically trip if they lose their lubrication/ cooling water supplied from the service water header.

(b) ... are controlled by a supervisory system with the master station at Caswell Beach and the remote station in the control room.

(c) ... are energized after the START command energizes the pump discharge valve open coil and an (54%) "open" limit switch is activated.

(d) ... are equipped with antireverse devices to limit high starting torques and currents during pump starts.

6.8 Answer the following with regard to the Instrument and Service Air System:

(a) The system includes four service air compressors (A-D), with the "D" compressor normally operating to supply plant air. How is the construction of this compressor different from the A-C compressors? (1.0)

(b) Compressor A, B, and C have a three-position switch which selects "high", "intermediate", or "low" modes of operation. What does this mean, and which mode(s) is (are) normally selected? (1.0)

(c) When will the emergency air compressors automatically start? (include setpoint(s)). (0.5)

6.9 (a) What components receive their cooling water supply from the vital service water header? (1.5)

(b) How are corrosion and fouling minimized in the vital service water header? (0.5)

6.10 (a) RFP turbine speed is controlled by a motor gear unit (MGU) or a motor speed changer (MSC). The MSC can control turbine speed from _____ to _____ and the MGU can control its speed from _____ to _____. The controller with the (lower/higher) speed demand will provide the control signal to the turbine. (1.5)

(b) The plant is operating at 100% power with the FWCS in 3-element control when an SRV inadvertently opens. Assuming no operator action, describe the response of the FWCS to this event. Describe and justify any changes in, and the final stable status of, reactor water level and feed pump speed with respect to their initial values. (2.0)

6.11 (a) A LOCA and a loss of off-site power have occurred simultaneously and the diesel generators have started and automatically energized their emergency buses. The sequential loading relays will delay the automatic starting of emergency loads for 5, 10, 15, or 20 seconds to minimize starting loads on the diesels. What loads will be energized at each of these time intervals? (2.0)

(b) List three (3) diesel generator auxiliary systems/components which continue to run for 20 minutes after a normal stop of the diesel generator is initiated. (1.5)

6.12 (a) List the six (6) trip circuits provided in the SRM channels. (1.5)

(b) What is the relative position of the IRM detectors with respect to the core when in the fully withdrawn and fully inserted positions? (1.0)

6.13 Answer the following with regard to the RHR system:

(a) For each of the following permissive/interlock setpoints state what permissive signal(s) is/are sent and where.

1. Reactor vessel pressure 410 psig decreasing and DW pressure 1.8 psig increasing.

2. Reactor vessel pressure 310 psig decreasing

3. RHR pump discharge pressure 115 psig increasing. (2.0)

(b) A LPCI signal is still present and the operator takes a running RHR pump switch to the STOP position. What indication will be received? (0.5)

(c) Identify all the operator actions which would restart the RHR pump secured in part (b). (1.0)

6.14 The RBCCW system supplies cooling water to four (4) components considered essential for safe shutdown of the reactor. What are those four components? (1.0)

WRITE "END OF CATEGORY 6"
ON YOUR ANSWER SHEET
AND START A NEW PAGE

7.0 PROCEDURES - NORMAL, ABNORMAL, EMERGENCY, AND RADIOLOGICAL CONTROL

7.1 a. GP-02, "Approach to Criticality and Pressurization of the Reactor," cautions that "if correct SRM/IRM overlap is not verified, the reactor shall be shutdown and the Nuclear Engineer notified." How is correct SRM/IRM overlap demonstrated? (1.0)

b. Place the following procedural steps from GP-02 into the proper sequence as they would be performed during an actual reactor plant startup and pressurization. (1.5)

1. Place HPCI in standby per OP-19.
2. Open the Steam Seal Main Steam Supply Valve.
3. Place a SJAE in service.
4. Start a Steam Packing Exhauster.
5. Place RCIC in standby per OP-16.
6. Start a Mechanical Vacuum Pump.

7.2 a. OP-27, "Generator and Exciter System Operating Procedure," cautions the operator to minimize turbine generator operation below 100 MWe. Briefly explain why this operating limitation is necessary. (1.0)

b. Per OP-27, "the power factor shall never be allowed to become less than _____." (0.5)

7.3 Answer the following questions with regard to reactor recirculation pump operational limitations and precautions:

a. GP-05, "Unit Shutdown," states that recirculation pump operation at suction pressure below 300 psig should be minimized. Why is this recommendation necessary? (0.5)

b. When increasing recirc pump speeds with both controllers in MANUAL, their speeds should normally be maintained within _____. The speed differential is limited to _____ when below 75% core flow and ____ when above 75% core flow. (1.5)

7.4 When, per GP-06, "Cold Shutdown to Refuel," is operating condition 5 entered? (1.0)

7.5 While operating at 100% power, an inadvertent HPCI initiation results in a "Moderator Temperature Decrease." Per AOP 03.0, which of the following operator actions is correct with regard to the recirculation pumps? (1.0)

a. Reduce recirc pump speed so that core flow is decreased by 20% below its level prior to the transient.

b. Reduce recirc pump speed so that core power is decreased by 20% below its level prior to the transient.

c. Slowly reduce recirc pump speed to maintain core thermal power below the APRM rod block setpoint.

d. Do not change recirc pump speed, but insert control rods to reduce thermal power below the APRM rod block setpoint.

7.6 Which of the following is <u>not</u> a symptom that you would expect to see as a result of a "Jet Pump Failure" (AOP-04.4)? (1.0)

a. Increase in core thermal power.

b. Increase in total core flow (indication).

c. Decrease in core plate differential pressure.

d. Increase in recirc loop flow (in loop with failed j.p.).

7.7 List the four (4) operator action steps required in response to a "Liquid Radioactive Spill" per AOP-05.2. (2.0)

7.8 AOP-15.0, "Alternate Shutdown Cooling," identifies five (5) conditions which must be met before that method of shutdown cooling may be used. What are four (4) of those five conditions? (2.0)

7.9 The plant is operating normally at approximately 85% power. Which of the following Statements describes the proper response to a "Low System Frequency" per AOP-22.0? (1.0)

a. When the "GEN BUS UNDER FREQ RELAY" annunciates, promptly reduce generator load to 100 MWe and separate the unit from the grid.

b. Increase unit output to the maximum consistent with plant conditions; if frequency decreases to 58.4 Hz commence a rapid shutdown per GP-05.

c. Increase recirc pump speed as necessary to maintain unit load as grid frequency decreases.

d. Increase unit output to maximum consistent with plant conditions; if frequency decreases to 58.4 Hz reduce load to 100 MWe and separate the unit from the grid.

7.10 AOP-32.0, "Plant Shutdown from Outside the Control Room," states that a minimum of five (5) persons would be required to perform such a shutdown on one unit. Where would those five persons be stationed for a remote shutdown on Unit 1? (All stations need not be permanent.) (2.5)

7.11 LEP-03, "Alternate Boron Injection," identifies the CRD pumps/system as one of six that may be selected and used to inject boron if the SLC system is not available when boron injection is required. Briefly describe the method/flow path which is established to accomplish this injection. (1.5)

7.12 The End Path Procedures (EPPs) direct the operator to depressurize the reactor when specific circumstances are encountered. Per the EPPs, what is the recommended method of depressurizing the reactor under the following situations: (1.0)

a. MSIVs open?
b. MSIVs closed?

7.13 Answer the following questions with regard to the Reactor Water Cleanup System Operating Procedure (OP-14):

a. Reactor Coolant temperature is 300°F and a major portion of the RWCU flow is being rejected to the condenser. Briefly explain why it is recommended that flow back to the reactor vessel be established slowly over a 45 minute period. (1.0)

b. OP-14 cautions the operator to maintain maximum RWCU System flow and temperature when operating at low power. Why is this practice recommended? (1.0)

7.14 An improper RBCCW system lineup could result in possible damage to the pumps and/or heat exchangers as stated in "CAUTIONS" in the system operating procedure (OP-21). Which of the following lineups/conditions would minimize the likelihood of component damage over an extended operating period? (1.0)

a. Running one RBCCW pump with two RBCCW heat exchangers.

b. Running two RBCCW pumps with two RBCCW heat exchangers.

c. Running two RBCCW pumps with one RBCCW heat exchanger.

d. Running two RBCCW pumps with three RBCCW heat exchangers.

7.15 What are four (4) items which must be verified by the operator per GP-05, "Unit Shutdown," prior to placing the reactor mode Switch in STARTUP-HOT STANDBY? (2.0)

WRITE "END OF CATEGORY 7" ON YOUR ANSWER SHEET AND START NEW PAGE

8.0 ADMINISTRATIVE PROCEDURES, CONDITIONS, AND LIMITATIONS

8.1 When performing system lineups or status checks in preparation for a plant startup per GP-01, certain systems can be signed off with either a "V" (valve lineup performed) or a "C". What conditions must be met in order to qualify for a "C" signoff? (1.5)

8.2 Temporary changes to operating procedures should be minimized. Under which one of the following conditions is a temporary change permitted and warranted? (1.0)

a. The addition of a caution is necessary to prevent possible equipment damage.

b. A correction is required to a valve/electrical lineup.

c. The plant physical conditions assumed by the procedure are incorrect and prevent its completion as written.

d. A procedural step is determined to be unnecessary and should be deleted.

8.3 Answer the following with regard to AI-59, "Jumpering, Wire Removal and Designated Jumper:"

a. What is meant by the term "designated jumper"? (1.0)

b. While reviewing a "Jumper and Wire Removal Approval" for a safety-related system, you notice the following entry in block 9 (Jumper No./Tag No(s).): "Window xx-xx-xx yellow dot." What does this indicate? (0.5)

8.4 a. Station clearances are under the control of the _____ and are issued for work involving equipment such as _____. (1.0)

b. Briefly explain the difference between a multiple clearance and a master clearance as described in AI-58, the "Equipment Clearance Procedure." (1.0)

8.5 a. Briefly explain how the "Overdue Date" is determined for a technical specification surveillance. (1.0)

b. On a weekly basis, Regulatory Compliance shall print and issue a surveillance "Status Check Report" to responsible subunits. What is the purpose of this weekly report? (1.0)

8.6 Which of the following statements correctly describes a Priority 1 work request per the "Corrective Maintenance" procedure, MP-14? (1.0)

a. It may be worked on a 24-hr/day, 7-day/week schedule upon approval by the General Manager.

b. It must be approved by the Shift Operating Supervisor and the Maintenance Supervisor.

c. The WR&A must be completed and signed prior to commencing the maintenance activity.

d. Priority 1 shall be assigned to all failures of safety-related equipment requiring immediate plant shutdown.

8.7 The "Conduct of Operations" section of the plant Administrative Procedure states that no recorder shall be removed from service without the Shift Foreman's permission. What three (3) things must be marked on a recorder chart that is removed from service? (1.5)

8.8 What is the difference between a DEPARTURE and a DEVIATION from an established procedure? (1.0)

8.9 The Control Operator is unable to perform one of the PTs on the DSR. How must he document the non-performance of the PT and how does he reschedule it prior to routing the DSR to the Shift Foreman for review? (1.0)

8.10 Until the EOF is activated, the Site Emergency Coodinator shall not delegate the responsibility for... (1.0)

a. ...directing the combined activities of plant personnel in the CR, TSC, and OSC.

b. ...requesting outside emergency assistance.

c. ...assessing the emergency condition for possible upgrade in classification.

d. ...deciding what protective action recommendations will be made to off-site authorities.

8.11 Each high radiation area in which the intensity of radiation is greater than _____ shall have a locked door(s) to prevent unauthorized entry. The keys to these doors shall be maintained under the administrative control of _____. (1.0)

8.12 Which one of the following events does NOT require a 1-hour Red Phone Report to the NRC? (1.0)

a. The initiation of a nuclear plant shutdown required by the plant's technical specification.

b. Any event that should have resulted in ECCS discharge into the reactor coolant system as a result of a valid signal.

c. Any event that may have caused exposure to the whole body of any individual to 25 rems or more of radiation.

d. Any event that results in manual or automatic actuation of an Engineered Safety Feature.

8.13 For each of the following conditions, state whether you would consider the system operable or inoperable per the T.S. and for each you consider inoperable, briefly state why you determined the system to be inoperable.

a. An emergency D.G. selected to CR Manual for Testing. (1.0)

b. Control of RHR Pumps B and D shifted to the Remote Shut Down Panel. (1.0)

8.14 List all the reactor coolant leakage detection systems which are required to be operable per Unit 2 TS 3/4.4.3. (1.5)

8.15 Attached TS Table 3.4.4-1, "Reactor Coolant System Chemistry Limits," provides the applicable limits based upon operational condition. What is the purpose of the chloride limit and why is it permitted to be higher in operational condition 1 than in condition 2? (i.e., what are TS bases?) (1.5)

8.16 The Unit 2 TS LCO for maximum suppression pool water temperature during Condition 1 or 2 is 95°F, with higher limits authorized under two exceptions. What are these exceptions and their associated limits? (2.0)

8.17 Core shutdown margin must be determined by measurement within 24 hrs. prior to or during the first startup after completing core alterations. It must show the core to be subcritical by at least R+____ delta k/k. The value of R must be positive or zero and in units of percentage delta k/k is the _____. (1.5)

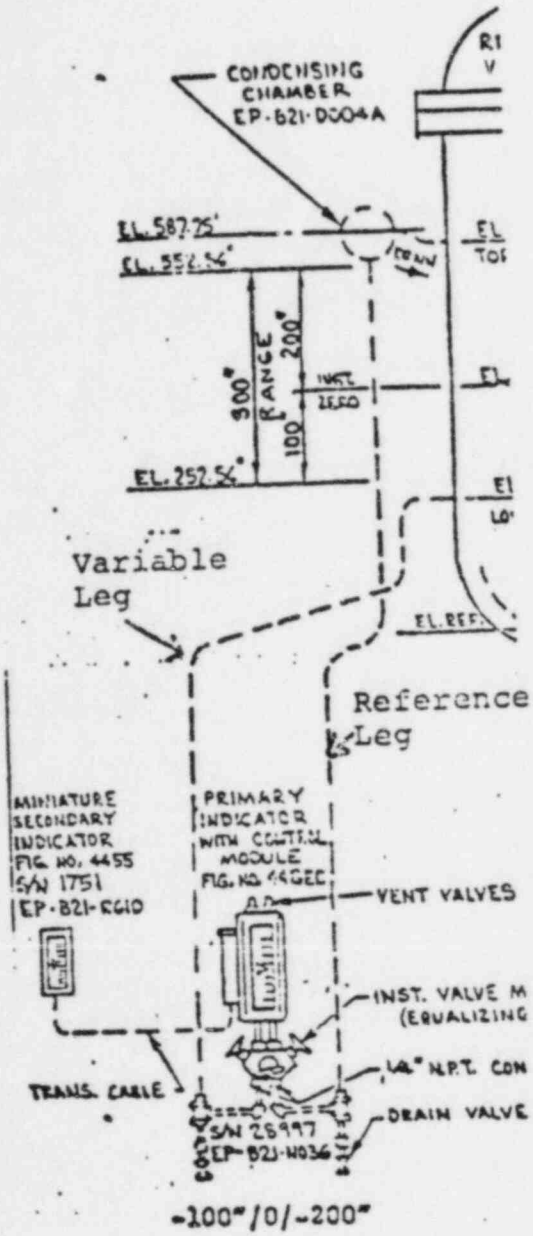


FIGURE B

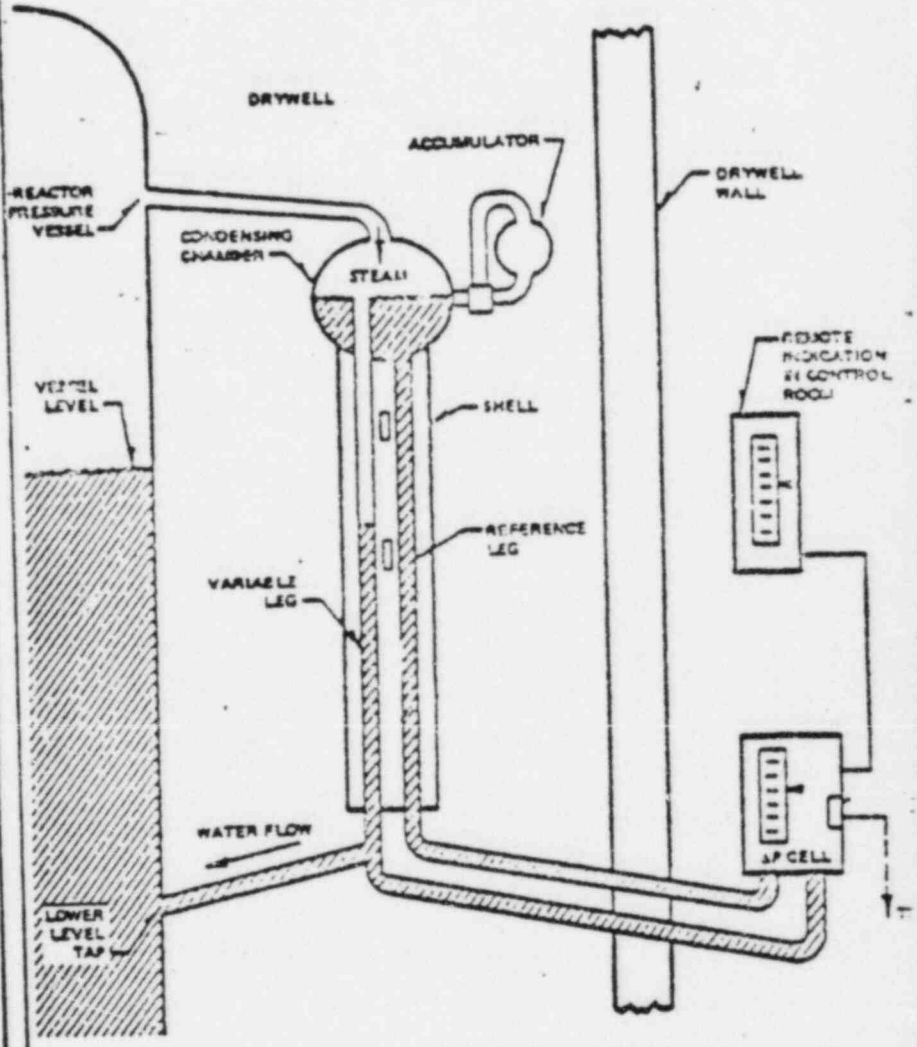


FIGURE A

Figure 5.8

BRUNSWICK STEAM ELECTRIC PLANT UNITS 1 & 2

Carolina Power & Light Company

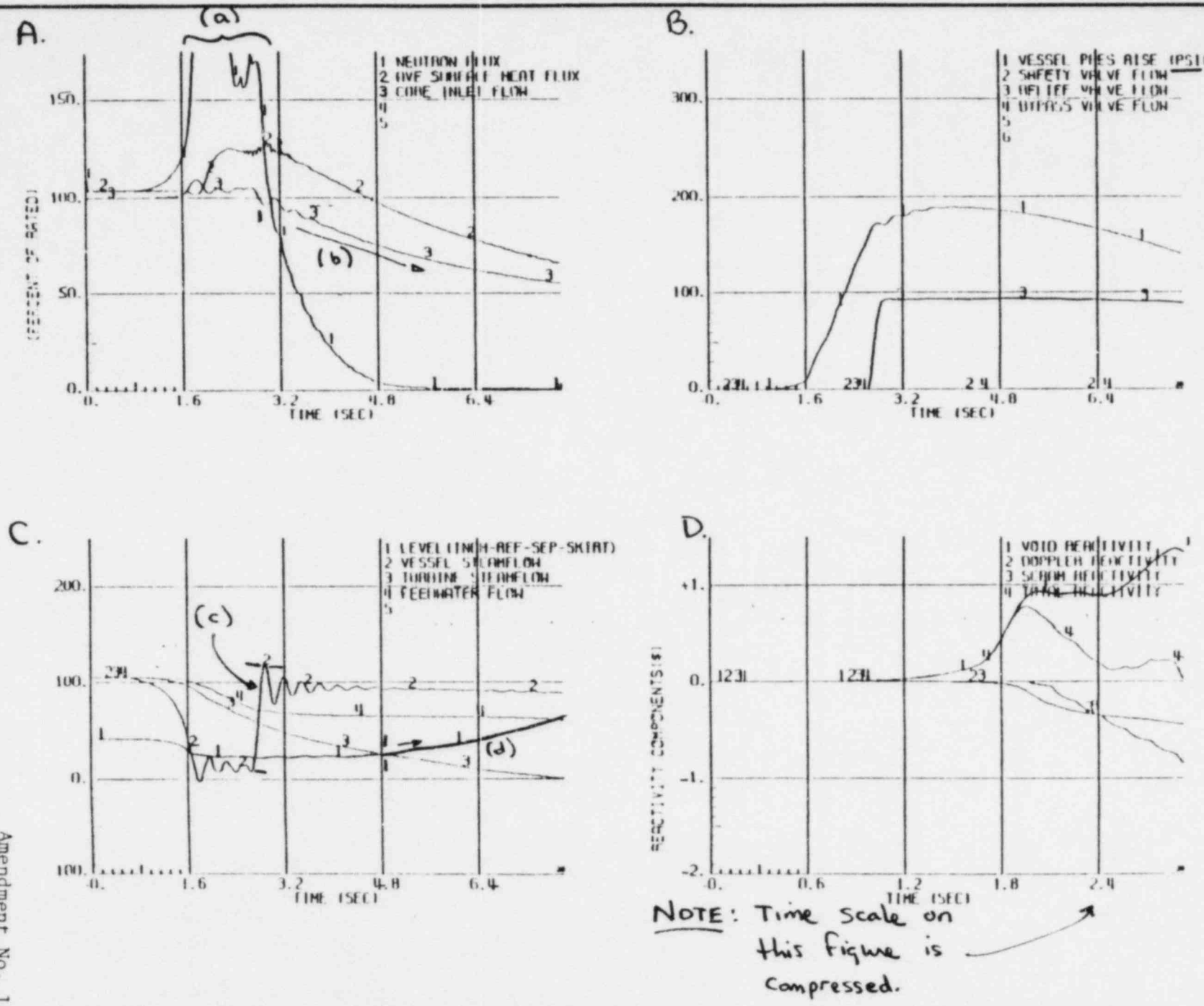
UPDATED FINAL SAFETY ANALYSIS REPORT

UNIT 2 - CYCLE 5 CLOSURE OF ALL MSIV FLUX SCRAM

FIGURE 15.2.3-4

Question 5.10

Amendment No. 1



NOTE: Time scale on this figure is compressed.

DATE 1-11-79 TIME 1505 UNIT 1 SEQ. NO. 3

PERIODIC NSS CORE PERFORMANCE LOG

LOCATION	1	2	3	4	5	6	7	8	9	10	11	12
AXIAL REL PWR	0.60	1.01	1.12	1.11	1.11	1.11	1.08	1.13	1.16	1.15	0.91	0.52
REGION REL PWR	0.92	1.02	0.92	1.09	1.01	1.09	0.92	1.02	0.92			
RING REL PWR	1.09	0.91	1.13	1.14	1.27	1.15	0.61					
APRM GAF	0.99	0.95	0.97	0.95	0.96	0.98						

REGION	1	2	3	4	5	6	7	8	9
MFLCPR	0.715	0.634	0.715	0.723	0.602	0.724	0.715	0.635	0.715
LOC	9-18	19-12	43-18	11-34	33-34	41-34	9-36	19-42	43-36
FLOW	0.0960	0.0966	0.0960	0.0947	0.0988	0.0947	0.0960	0.0966	0.0960
PKF	1.51	1.29	1.51	1.45	1.23	1.45	1.51	1.29	1.51
MFLPD	0.689	0.613	0.688	0.661	0.525	0.662	0.688	0.613	0.688
LOC	9-18-20	25-10- 5	43-18-20	13-32-17	33-34-19	39-22-17	9-33-20	25-44- 5	43-36-20
PKFL	2.25	2.00	2.25	2.16	1.75	2.16	2.25	2.00	2.25
MAXEQ	0.226	0.187	0.226	0.219	0.172	0.219	0.226	0.187	0.226
LOC	9-18	25-10	43-18	11-34	33-34	41-34	9-36	25-44	43-36
FLOW	0.0960	0.0983	0.0960	0.0947	0.0988	0.0947	0.0960	0.0983	0.0960
PKF	1.51	1.32	1.51	1.45	1.23	1.45	1.51	1.32	1.51

FAILED SENSORS

FAILED LPRM LIST

3613,A,1 4437,D,2

BASE CRIT CODE

4437,2

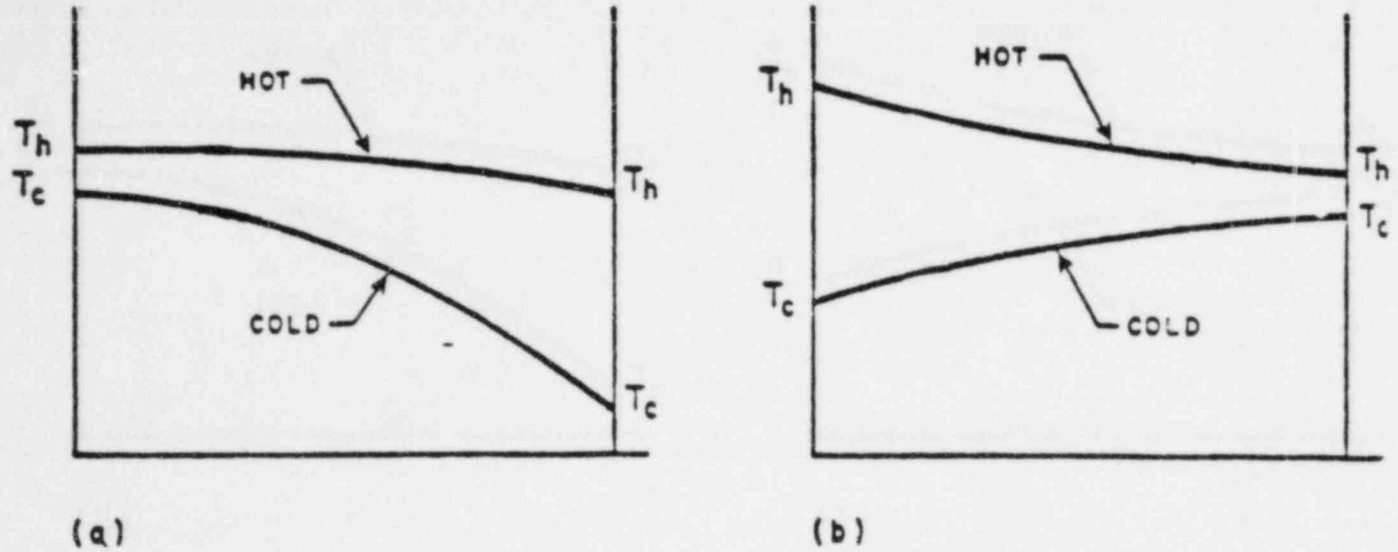
CMWT	1779.
GMWE	600.6
CMFCP	0.724
CMFLPD	0.689
CMPF	2.251
CMEQ	0.226
CAEQ	0.121
CAQA	0.113
CAVF	0.362
CAPD	37.39
CRD	0.078
CRSYM	2.
PR	981.
DPC-M	12.08
DPC-C	12.89
RWL	36.49
DHS	19.91
WFW	7.27
WD	25.33
WTSUB	61.48
WTHB	-1.00
WT	61.23
WTFLAG	2.
ITER	3.
IREC	0.
IEQL	1.
IXYFLG	0.

1391

Figure 5.11

Table 2
Properties of saturated steam and saturated water (pressure)

Press. psia	Temp F	Volume, ft³/lb			Enthalpy, Btu/lb			Entropy, Btu/lb, F			Energy, Btu/lb		Pres psi
		Water	Evap	Steam	Water	Evap	Steam	Water	Evap	Steam	Water	Steam	
		v_f	v_{fg}	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	u_f	u_g	
0.0886	32.018	0.01602	3302.4	3302.4	0.00	1075.5	1075.5	0	2.1872	2.1872	0	1021.3	0.08
0.10	35.023	0.01602	2945.5	2945.5	3.03	1073.8	1076.8	0.0061	2.1705	2.1766	3.03	1022.3	0.1
0.15	45.453	0.01602	2004.7	2004.7	13.50	1067.9	1081.4	0.0271	2.1140	2.1411	13.50	1025.7	0.1
0.20	53.160	0.01603	1526.3	1526.3	21.22	1063.5	1084.7	0.0422	2.0738	2.1160	21.22	1028.3	0.2
0.30	64.484	0.01604	1039.7	1039.7	32.54	1057.1	1089.7	0.0641	2.0168	2.0809	32.54	1032.0	0.3
0.40	72.869	0.01606	792.0	792.1	40.92	1052.4	1093.3	0.0799	1.9762	2.0562	40.92	1034.7	0.4
0.5	79.586	0.01607	641.5	641.5	47.62	1048.6	1096.3	0.0925	1.9446	2.0370	47.62	1036.9	0.5
0.6	85.218	0.01609	540.0	540.1	53.25	1045.5	1098.7	0.1028	1.9186	2.0215	53.24	1038.7	0.6
0.7	90.09	0.01610	466.93	466.94	58.10	1042.7	1100.8	0.3	1.8966	2.0083	58.10	1040.3	0.7
0.8	94.38	0.01611	411.67	411.69	62.39	1040.3	1102.6	0.1117	1.8775	1.9970	62.39	1041.7	0.8
0.9	98.24	0.01612	368.41	368.43	66.24	1038.1	1104.3	0.1264	1.8606	1.9870	66.24	1042.9	0.9
1.0	101.74	0.01614	333.59	333.60	69.73	1036.1	1105.8	0.1326	1.8455	1.9781	69.73	1044.1	1.0
2.0	126.07	0.01623	173.74	173.76	94.03	1022.1	1116.2	0.1750	1.7450	1.9200	94.03	1051.8	2.0
3.0	141.47	0.01630	118.71	118.73	109.42	1013.2	1122.6	0.2009	1.6854	1.8864	109.41	1056.7	3.0
4.0	152.96	0.01636	90.63	90.64	120.92	1006.4	1127.3	0.2199	1.6428	1.8626	120.90	1060.2	4.0
5.0	162.24	0.01641	73.515	73.53	130.20	1000.9	1131.1	0.2349	1.6094	1.8443	130.18	1063.1	5.0
6.0	170.05	0.01645	61.967	61.98	138.03	996.2	1134.2	0.2474	1.5820	1.8294	138.01	1065.4	6.0
7.0	176.84	0.01649	53.634	53.65	144.83	992.1	1136.9	0.2581	1.5587	1.8168	144.81	1067.4	7.0
8.0	182.86	0.01653	47.328	47.35	150.87	988.5	1139.3	0.2676	1.5384	1.8060	150.84	1069.2	8.0
9.0	188.27	0.01656	42.385	42.40	156.30	985.1	1141.4	0.2760	1.5204	1.7964	156.28	1070.8	9.0
10	193.21	0.01659	38.404	38.42	161.26	982.1	1143.3	0.2836	1.5043	1.7879	161.23	1072.3	10
14.696	212.00	0.01672	26.782	26.80	180.17	970.3	1150.5	0.3121	1.4447	1.7568	180.12	1077.6	14.6
15	213.03	0.01673	26.274	26.29	181.21	969.7	1150.9	0.3137	1.4415	1.7552	181.16	1077.9	15
20	227.96	0.01683	20.070	20.087	196.27	960.1	1156.3	0.3358	1.3962	1.7320	196.21	1082.0	20
30	250.34	0.01701	13.7266	13.744	218.9	945.2	1164.1	0.3682	1.3313	1.6995	218.8	1087.9	30
40	267.25	0.01715	10.4794	10.497	236.1	933.6	1169.8	0.3921	1.2844	1.6765	236.0	1092.1	40
50	281.02	0.01727	8.4967	8.514	250.2	923.9	1174.1	0.4112	1.2474	1.6586	250.1	1095.3	50
60	292.71	0.01738	7.1562	7.174	262.2	915.4	1177.6	0.4273	1.2167	1.6440	262.0	1098.0	60
70	302.93	0.01748	6.1875	6.205	272.7	907.8	1180.6	0.4411	1.1905	1.6316	272.5	1100.2	70
80	312.04	0.01757	5.4536	5.471	282.1	900.9	1183.1	0.4534	1.1675	1.6208	281.9	1102.1	80
90	320.28	0.01766	4.8777	4.895	290.7	894.6	1185.3	0.4643	1.1470	1.6113	290.4	1103.7	90
100	327.82	0.01774	4.4133	4.431	298.5	888.6	1187.2	0.4743	1.1284	1.6027	298.2	1105.2	100
120	341.27	0.01789	3.7097	3.728	312.6	877.8	1190.4	0.4919	1.0960	1.5879	312.2	1107.6	120
140	353.04	0.01803	3.2010	3.219	325.0	868.0	1193.0	0.5071	1.0681	1.5752	324.5	1109.6	140
160	363.55	0.01815	2.8155	2.834	336.1	859.0	1195.1	0.5206	1.0435	1.5641	335.5	1111.2	160
180	373.08	0.01827	2.5129	2.531	346.2	850.7	1196.9	0.5328	1.0215	1.5543	345.6	1112.5	180
200	381.80	0.01839	2.2689	2.287	355.5	842.8	1198.3	0.5438	1.0016	1.5454	354.8	1113.7	200
250	400.97	0.01865	1.8245	1.8432	376.1	825.0	1201.1	0.5679	0.9585	1.5264	375.3	1115.8	250
300	417.35	0.01889	1.5238	1.5427	394.0	808.9	1202.9	0.5882	0.9223	1.5105	392.9	1117.2	300
350	431.73	0.01913	1.3064	1.3255	409.8	794.2	1204.0	0.6059	0.8909	1.4968	408.6	1118.1	350
400	444.60	0.0193	1.14162	1.1610	424.2	780.4	1204.6	0.6217	0.8630	1.4847	422.7	1118.7	400
450	456.28	0.0195	1.01224	1.0318	437.3	767.5	1204.8	0.6360	0.8378	1.4738	435.7	1118.9	450
500	467.01	0.0198	0.90787	0.9276	449.5	755.1	1204.7	0.6490	0.8148	1.4639	447.7	1118.8	500
550	476.94	0.0199	0.82183	0.8418	460.9	743.3	1204.3	0.6611	0.7936	1.4547	458.9	1118.6	550
600	486.20	0.0201	0.74962	0.7698	471.7	732.0	1203.7	0.6723	0.7738	1.4461	469.5	1118.2	600
700	503.08	0.0205	0.63505	0.6556	491.6	710.2	1201.8	0.6928	0.7377	1.4304	488.9	1116.9	700
800	518.21	0.0209	0.54809	0.5690	509.8	689.6	1199.4	0.7111	0.7051	1.4163	506.7	1115.2	800
900	531.95	0.0212	0.47968	0.5009	526.7	669.7	1196.4	0.7279	0.6753	1.4032	523.2	1113.0	900
1000	544.58	0.0216	0.42436	0.4460	542.6	650.4	1192.9	0.7434	0.6476	1.3910	538.6	1110.4	1000
1100	556.28	0.0220	0.37863	0.4006	557.5	631.5	1189.1	0.7578	0.6216	1.3794	553.1	1107.5	1100
1200	567.19	0.0223	0.34013	0.3625	571.9	613.0	1184.8	0.7714	0.5969	1.3683	566.9	1104.3	1200
1300	577.42	0.0227	0.30722	0.3299	585.6	594.6	1180.2	0.7843	0.5733	1.3577	580.1	1100.9	1300
1400	587.07	0.0231	0.27871	0.3018	598.8	576.5	1175.3	0.7966	0.5507	1.3474	592.9	1097.1	1400
1500	596.20	0.0235	0.25372	0.2772	611.7	558.4	1170.1	0.8085	0.5288	1.3373	605.2	1093.1	1500
2000	635.80	0.0257	0.16266	0.1883	672.1	466.2	1138.3	0.8625	0.4256	1.2881	662.6	1068.6	2000
2500	668.11	0.0286	0.10209	0.1307	731.7	361.6	1093.3	0.9139	0.3206	1.2345	718.5	1032.9	2500
3000	695.33	0.0343	0.05073	0.0850	801.8	218.4	1020.3	0.9728	0.1891	1.1619	782.8	973.1	3000
3208.2	705.47	0.0508	0	0.0508	906.0	0	906.0	1.0612	0	1.0612	875.9	875.9	3200



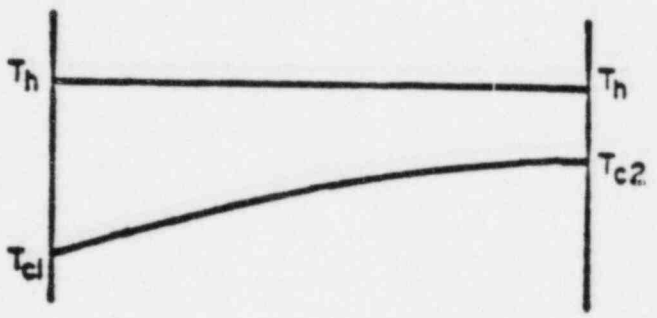


Figure 5.15

EQUATION SHEET

$f = ma$

$v = s/t$

Cycle efficiency = (Net work out)/(Energy in)

$w = mg$

$s = V_o t + 1/2\ at^2$

$E = mc^2$

$KE = 1/2\ mv^2$

$a = (V_f - V_o)/t$

$A = \lambda N$ $\quad A = A_o e^{-\lambda t}$

$PE = mgh$

$w = \theta/t$

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

$V_f = V_o + at$

$A = \frac{\pi D^2}{4}$

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

$W = v\ \Delta P$

$\dot{m} = V_{av} A_p$

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

$\Delta E = 931\ \Delta m$

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

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

$I = I_o e^{-ux}$

$Pwr = W_f \Delta h$

$I = I_o 10^{-x/TVL}$

$TVL = 1.3/u$

$HVL = -0.693/u$

$p = p_o 10^{SUR(t)}$

$p = p_o e^{t/T}$

$SUR = 26.06/T$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$I_1 d_1 = I_2 d_2$

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

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

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

$P = (\Sigma_a \phi V)/(3 \times 10^{10})$

$\Sigma = \sigma N$

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

TABLE 3.4.4-1

REACTOR COOLANT SYSTEM CHEMISTRY LIMITS

OPERATIONAL CONDITION	CHLORIDES	CONDUCTIVITY (μmhos/cm @25°C)
1	< 0.5 ppm	< 2.0
2	< 0.2 ppm	< 2.0
At all other times	< 0.2 ppm	<10.0

Question 8.15

5.0 Answers

5.1 (b) (1.0)

REF: BSEP "Core Parameters and Thermal Limits", III.B

5.2 (c) (1.0)

REF: BSEP "Reactor Theory Part II", sheet 16-23

5.3 (a) (1.0)

REF: BSEP "Reactor Theory Part II", sheet 8-9

5.4 (d) (1.0)

REF: BSEP "Reactor Theory Part II", sheet 44-45

5.5 (c) (1.0)

REF: BSEP "Reactor Theory Section I", p. 16
BSEP "Reactor Theory Part II", sheet 2, 11, 15

5.6 (a) (1.0)

REF: Steam Tables

5.7 (c) (1.0)

REF: BSEP "Fluid Flow", p. 66

5.8 (a) 1. detector "A" (0.5)
2. detector "B" (0.5)

(b) Indicated level would be above actual level [0.5] because the fuel zone level detector taps into the jet pump instrument line [0.25] and is calibrated with no jet pump flow [0.25]. (1.0)

REF: BSEP Mitigating Core Damage Study Guide, p. 19-26

5.9 1. Boiling in the core [0.5] drives NC flow from the downcomer through the jet pumps and into the shroud region [0.5]. (1.0)

2. A difference in density between the fluid in the bypass region and the boiling region within the active fuel [0.5] drives a NC loop inside the shroud [0.5]. (1.0)

REF: BSEP Mitigating Core Damage Study Guide, p. 36-37

5.10 (a) MSIV closure causes a rapid pressure increase which collapses voids causing a positive reactivity insertion. (0.5)

(b) The recirculation pumps trip on high reactor pressure (ATWS). (0.5)

(c) The SRVs are opening due to high reactor pressure. (0.5)

(d) Decreasing reactor pressure (due to SRV opening) causes an increase in core voiding and vessel level. (0.5)

(e) The reactor should have scrammed due to MSIV position (<90%) [0.5]. This scram anticipates the pressure and flux transients which occur during isolation valve closure [0.5]. (1.0)

REF: BSEP FSAR figure 15.2.3-4
Simulator Malfunction #166
RSP Study Guide 3, p.6-7

5.11 (a) AGAF = 0.97
CMWT = 1779
RTP = 2436 MWT [0.2]

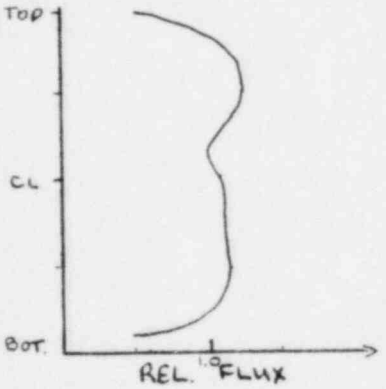
$\frac{1779}{2436} \times 100\% = 73.03\%$ RTP [0.3]

$\frac{73.03\%}{0.97} = 75.29\%$ indicated power on APRM "3" [0.5] (1.0)

(b) $MFLCPR = \frac{CPRLIM}{CPR(actual)} = .724$ [0.5]

$CPR\ (actual) = \frac{CPRLIM}{MFLCPR} = \frac{1.3}{0.724} = 1.795$[0.5] (1.0)

(c) (1.0)



REF: BSEP Core Parameters and Thermal Limits Study Guide

5.12 (a) Radiolytic decomposition of water. (0.5)

(b) Metal (Fuel cladding) to water reaction. (0.5)

(c) oxygen: 5%
hydrogen: 4% (0.5)

REF: BSEP Mitigating Core Damage Study Guide, p. 39-40

5.13 (a) The soak period allows the fuel rod (clad) time to expand elastically to accommodate the stress exerted on it by the pellet. (0.5)

(b) Find time 12 hrs. prior to reduction: 0300 - 12 hours = 1500

Find nodal power at 1500:

11.0 kw/ft + (15 hours x 0.10 kw/ft/hr) = 12.5 kw/ft

Power was $\geq$ 12.5kw/ft for 12 hours so this becomes the valid preconditioned value for that node. [0.5]

Power can be returned to 13.0kw/ft at 0.10kw/ft/hr [0.5]. (1.0)

(c) The "envelope" is the range of power between the threshold power [0.5] and the preconditioned power [0.5]. (1.0)

REF: BSEP PCIOMR Study Guide, p. 3,7,8

5.14 This ensures that the B_{10} adds negative reactivity [0.5] at a faster rate than positive reactivity can be added due to reactor cooldown [0.5]. (1.0)

REF: BSEP, SD-05, p .1

5.15 (a) It improves overall plant efficiency (as much as 5%). (0.5)

(b) (b) (0.5)

REF: BSEP FW heaters and Drains Study Guide, p .1
BSEP Heat Transfer (FQ), p. 7-15

5.16 (a) Neutron sensitivity decreases due to Uranium depletion [0.5] but gamma sensitivity doesn't change due to constant argon pressure [0.5]. (1.0)

(b) 1. Absorption gammas.
2. Fission product decay gammas. (1.0)

REF: BSEP LPRM Study Guide, p. 2
BSEP SRM Study Guide, p. 4

6.0 Answers

6.1 (b) (1.0)

REF: BSEP SD-01, p. 6

6.2 (c) (1.0)

REF: BSEP SD-4, p. 34
BSEP SD-24, p. 7

6.3 (b) (1.0)

REF: BSEP SD-7, p. 3, 7, 20

6.4 (d) (1.0)

REF: BSEP SD-11, p. 38

6.5 (a) (1.0)

REF: BSEP SD-12, p .2

6.6 (c) (1.0)

REF: BSEP SD-16, p .13
BSEP SD-12, p.6

6.7 (c) (1.0)

REF: BSEP Main Circulating Water System Study Guide, p. 48

6.8 (a) Compressor "D" is a rotary screw compressor [0.5] while "A-C" are reciprocating (double acting, single stage) compressors [0.5] (1.0)

(b) The "high-inter-low" switch determines the pressure band within which that compressor will load and unload [0.5]. All three compressors normally operate in the "low" pressure band [0.5]. (1.0)

(c) When instrument air pressure decreases to 95 psig. (0.5)

REF: BSEP SD-46, p. 2-6

6.9 (a) RHR pump room cooler
RHR pump seal Hxs
Core Spray pump room coolers (0.5 ea/1.5)

(b) ~~The piping is laid up with well water.~~ (0.5)

REF: BSEP SD-43, p .3

6.10 (a) MCS - 0 to 5800 RPM (0.5)
MGU - 2825 to 5800 RPM (0.5)
lower (0.5)

(b) Level will initially swell due to decreased Rx pressure [0.5] and RFP speed will decrease due to the higher level and the M_{stm}/M_{fw} mismatch [0.5]. This will cause level to decrease and stabilize at a lower level to offset the M_{stm}/M_{fw} mismatch in FWCS [0.5]. RFP speed will return to its original value when the level and flow error are balanced [0.5]. (2.0)

REF: BSEP SD 32-2, p. 16-17, BSEP Simulator Malfunction #156

6.11 (a) 5 seconds - Nuclear Service Water Pump
10 seconds - RHR Pump
15 seconds - Core Spray Pump
20 seconds - Fire Pump Power Supply Breaker (2.0)

(b) 1. Auxiliary Lube oil pump
2. Auxiliary jacket water pump
3. Crankcase vacuum blower (1.5)

REF: BSEP SD-50.1, p .3
BSEP SD-39, p .3

6.12 (a) 1. Downscale
2. Inoperative
3. Retract Permissive
4. Upscale (Alarm)
5. Period
6. Upscale Trip (0.25ea/1.5)

(b) Inserted - 18" above CL
withdrawn - 30" below bottom (0.5ea/1.0)

REF: BSEP SD-09-1, p. 1-1

6.13 (a) 1. RHR pump start permissive [0.5] and LPCI injection valve open permissive [0.5].
2. Recirc pump discharge valve closure [0.5].
3. ADS logic initiation permissive [0.5]. (2.0)

(b) The white light associated with that pump will illuminate. (0.5)

(c) 1. Take the manual control switch to START (spring return to Auto).
2. Reset the LPCI initiation signal (by depressing the PB). (1.0)

REF: BSEP SD-17, p. 9, 33
BSEP SD-01, p. 51

6.14

1. Recirculation pump (and motor) coolers
2. DW equipment drain tank coolers
3. Penetration coolers
4. Drywell coolers (0.25ea/1.0)

REF: BSEP SD-21, p .1

7.0 ANSWERS

7.1 a. At least 3 IRM channels in each RPS trip system show an increase in reading [0.5] before the first SRM channel reaches 10^5 CPS [0.5]. (1.0)

b. 4,2,6,5,1,3 (1.5)

Ref: BSEP GP-02, P.13, 15-21

7.2 a. To prevent cooling the LP turbine's diaphragm below 120°F [0.5] which may cause severe turbine damage [0.5]. (1.0)

b. less than unity in the leading direction (negative or incoming VARS) (0.5)

Ref: BSEP OP-27, P.14,15

7.3 a. Such operations can shorten seal life. (0.5)

b. 1%, 5%, 10% (1.5)

Ref: BSEP GP-04, P.4
BSEP GP-05, P.5

7.4 When the vessel head bolts are detensioned. (1.0)

Ref: BSEP GP-06, P.7

7.5 (b) (1.0)

Ref: BSEP AOP 03.0, P.4

7.6 (a) (1.0)

Ref: BSEP AOP-04.4, P.3

7.7 1. Announce that there is a radioactive liquid spill (and state location. Have personnel leave the spill location in an orderly manner.)

2. Stop the source of the spill (and cover the spill with absorbent material.)

3. Notify E & RC.

4. (If possible) secure ventilation in the spill area (to minimize evaporation.) (0.5 ea/2.0)

Ref: BSEP AOP-05.2, P.3

7.8 1. All control rods must be fully inserted.

2. Reactor pressure must be below the SDC interlocks.

3. RHR SDC cannot be established.

4. All other methods of SDC (have been attempted and) were unsuccessful.

5. Further cooldown of the reactor is required. (4 of 5 @ 0.5/2.0)

Ref: BSEP AOP-15.0, P.3

7.9 (d) (1.0)

Ref: BSEP AOP-22.0, P.3-5

7.10 1. The Remote Shutdown Panel Operator (RB, 20' El., vicinity MCC-1XB)

2. MCC-1XB, 1XDB operator (RB, 20' El.)

3. MCC-1XA, IXDA operator (RB, 20' El.)

4. 4KV bus operator (DB, 50' El.)

5. MCC-1XC (RB, 20' El.) (0.5 ea/2.5)

Ref: BSEP AOP-32.0, P.4, 26

7.11 A flow path is set up from the SLC tank drain [0.5] via a temporary hose [0.5] to the CRD pump suction line vent [0.5]. (1.5)

Ref: BSEP LEP-03, P. 17

7.12 a. Rapidly depressurize the reactor with the bypass valve opening jack. (0.5)

b. Manually open all ADS valves. (0.5)

Ref: BSEP EPP-1P, P.5
BSEP EPP-1M, P.4

7.13 a. To prevent regenerative Hx tube damage [0.5] due to rapid cooldown rate [0.5]. (1.0)

b. To minimize thermal duty on the feedwater nozzles. (1.0)

Ref: BSEP OP-14, P.11, 31

7.14 (b) (1.0)

Ref: BSEP OP-21, P. 6, 7, 16

7.15 1. All operable IRM channel Upscale Trips (or INOP lights) are off.

2. Inoperable IRMs and/or SRMs are bypassed on the RTGB.

3. At least three IRMs per trip channel are operable.

4. All operable APRM channels indicate less than 11%.

5. PT-01.2.3 PC is current.

6. All items in the AO and CO DSR applicable to Oper. Cond. 2 are current. (4 of 6 @ 0.5/2.0)

Ref: BSEP GP-05, P.23

8.0 Answers

8.1 The system has not undergone significant maintenance or modification (and there is no reason to believe its status has changed significantly since the last valve lineup) [0.5], the last valve lineup was completed within the last refuel cycle ~~a year~~ [0.5], and all control room controls and indications are checked [0.5]. (1.5)

REF: BSEP GP-01, P. 5-7 ; Rev 95

8.2 (c) (1.0)

REF: BSEP OI-28, P. 2

8.3 a. The jumper is uniquely identified [0.5] and physically controlled [0.5]. (1.0)

b. The annunciator's audible alarm feature is altered (by installation of a modified card). (0.5)

REF: BSEP AI-59, P. 3, 4

8.4 a. dispatcher
switchyard equipment (generator stators field breakers) (0.5 ea/1.0)

b. A multiple clearance is issued to two or more individuals whose work has the same boundaries [0.5] while a master clearance is issued to a foreman who is responsible for two or more jobs within the same boundaries [0.5]. (1.0)

REF: BSEP AI-58, P. 1, 2

8.5 a. The surveillance interval has a maximum allowable extension of $\leq$25% [0.5] with a maximum combined time interval for three consecutive surveillance intervals of $\leq$3.25 times the TS interval [0.5]. (1.0)

b. To provide an early warning of surveillances which have a potential for becoming overdue. (1.0)

REF: BSEP RCI-02.4, P. 4, 8
BSEP TS 4.0.2

8.6 (b) (1.0)

REF: BSEP MP-14, P. 2, 3, 21

8.7 1. The initials of the person who removed the recorder from service.

2. The date and time of removal from service.

3. The reason for the recorder's removal from service. (0.5 ea/1.5)

REF: BSEP AP-Vol. 1, P. 4-5

8.8 A departure may change the intent of the procedure [0.5] while a deviation may not [0.5]. (1.0)

REF: BSEP AP-Vol. 1, P. 5-6

8.9 He must enter the reason for non-performance on the Completion/Exception Form [0.5] and tentatively reschedule the PT in red on the Rescheduling PT Sheet [0.5]. (1.0)

REF: BSEP OI-03, P. 1, 3

8.10 (d) (1.0)

REF: BSEP PEP 02.2, P. 2

8.11 1000 mRem/hr.
Radiation Control Supervisor on duty (0.5 ea/1.0)

REF: E&RC Manual, Vol. VIII, P. 33

8.12 (d) (1.0)

REF: BSEP RCI-06.5, P. 5-8

8.13 a. Operable (1.0)

b. Inop LPCI loop B [0.25] - RHR-LPCI Pumps B&D will not auto start on ECCS initiation signal when transferred to remote SD panel [0.75]. (1.0)

REF: Brunswick RTN-031, Brunswick RTN Ques. 31-5.

8.14 1. Primary containment atmosphere particulate radioactivity monitoring system.

2. The primary containment sump flow integrating system.

3. The primary containment gaseous radioactivity monitoring system. (0.5 ea/1.5)

REF: BSEP 11-2 TS, P. 3/4 4-5

8.15 The chloride concentration is limited to prevent stainless steel stress corrosion cracking [0.5]. The effect of the chloride is reduced when oxygen concentration in the coolant is low [0.5], therefore, a higher chloride level is permitted during full power operation [0.5]. (1.5)

REF: BSEP U-2 TS, P. 3/4 4-9, B 3/4 4-2

8.16 1. 105°F [0.25] during testing which adds heat to the suppression pool during condition 1 or 2 [0.75].

2. 120°F [0.25] with the MSIVs closed following a scram from Operation Condition 1 [0.75]. (2.0)

REF: BSEP U-2 TS, P. 3/4 6-9

8.17 0.38% [0.5]

... the difference between the calculated value of maximum core reactivity during the operating cycle and the calculated BOL reactivity [1.0] (1.5)

REF: BSEP U-2 TS, P. B 3/4 1-1