Examination Report No. 50-397/OL-84-03

Facility: Washington Nuclear Plant No. 2

Docket No. 50-397

Examinations administered at Washington Nuclear Plant No. 2, Richland, Washington from November 6 to November 8, 1984.

Chief Examiner:

C Gage for:

Date Signed

Operator License Examiner

Approved:

L of Flin Chief

Date Signed

Operations Section (Acting)

Summary:

Examinations on November 6-8, 1984

Written examinations were administered to eight SRO and one RO candidates. Operating examinations (Oral and simulator) were administered to eight SRO and one RO candidates. Four SRO candidates passed the examinations.

REPORT DETAILS

1. Persons Examined

Examinations were administered to nine candidates; one Reactor Operator candidate, and eight Senior Operator candidates.

2. Examiners

Paul Gage Ira Levy Gary Sly

3. Examination Review Meeting

An exam review meeting was held immediately after the written exams were administered, on November 6, 1984. The following utility representatives were in attendance:

John Wyrick
Mike Kappl
Bob Beardsly
Andy Langdon
Mark Westergren
Tim Messersmith
Steve Redniak
Ed Wright

Additionally, the following NRC representatives were present:

Robert Pate
Paul Gage
Ira Levy
Gary Sly
Gary Johnston (observer)

The responses to the comments provided by the utility representatives are included as enclosure (1). Additional comments were provided by letter from G. C. Sorensen to J. B Martin, dated November 13, 1984. The responses to these comments are included as enclosure (2). Where applicable the examination keys have been changed.

4. Exit Meeting

An exit meeting was held with the facility on November 9, 1984. The attendees were:

NRC:

Robert Pate - Chief, Reactor Safety Branch Paul Gage - NRC Examiner Gary Johnston - NRC Examiner (Observer) Al Toth - Sr. Resident Inspector

Utility:

Jack Shannon - Director, Power Generation
Jerry Martin - Plant Manager, WNP-2
Roger Corcoran - WNP-2 Operations Manager
Clu Powers - Assistant Plant Manager, WNP-2
John Wyrick - Nuclear License Training Manager
Rich Stickney - Manager Technical Training
John Little - Plant Training Coordinator

The candidates that were a clear pass on the Operating Examination (Oral and Simulator) were identified.

A discussion of how Job Task Analysis (JTA) would be used in future examinations was held. It was explained to the facility personnel that the written examinations for this examination were not based on JTA.

The current status of the plant simulator was discussed. The NRC position was that the simulator was very limited in its present state and was barely satisfactory for use in examinations. The facility staff stated that there were plans to improve the condition of the simulator.

RO/SRO EXAM REVIEW COMMENTS AND RESOLUTIONS

Comments on the following questions were accepted and the master answer key suitably modified:

RO Exam

Section 1: 1.2a; 1.6;

Section 2: 2.2b; 2.2d; 2.3a(2); 2.4b(3); 2.7a, 2.7d; 2.9b

Section 3: 3.5a; 3.5b; 3.6c; 3.8b; 3.8c

Section 4: 4.3b(4); 4.4b; 4.14

SRO Exam

Section 5: 5.7b; 5.8; 5.10.

Section 6: 6.1b (2); 6.2a; 6.3a; 6.5b; 6.6; 6.8; 6.9a.

Section 7: 7.2; 7.5b.

Section 8: 8.2b; 8.3; 8.8a; 8.11.

Comments on the following questions were not accepted as explained below.

kO Exam

Section 1

Question 1.1

Facility Comment: Request partial credit for using period of 40 second.

Response: Knowledge of "doubling time" is important part of question.
Anyone can plug equation if period is given in seconds.

No change to answer key.

Ouestion 1.13.b

Facility Comment: Assuming no change in core average neutron flux.

Response: Question said "taken separately" and core average flux is

part of question 1.13.c. No change to answer key.

Question 1.13.c

Facility Comment: Assuming no change in local flux. Usually local flux will

change and could result in no change in core average flux.

Response: Even if an increase in core average flux did cause an

increase in local flux, the change would be small relative to that of the core. The ratio of the square of the local over the average would still decrease and, therefore, so

would differential rod worth.

Section 2

Question 2.2.a

Facility Comment: Facility requests low level alarm be acceptable as a safety

function. Also comment that level 4 may not necessarily be

assumed to be coincident with loss of a RFP.

Response: A low level alarm is not an auto-initiated safety

function. No credit for that answer. Recirculation pump run back will only occur, if there is a low level and a

coincident loss of one reactor feed pump.

Question 2.4.a

Facility Comment: Other acceptable answers are:

- (1) SRM, IRM, APRM slide links for bypassing non coincident scrams.
- (2) Manual bypass of IRM.
- (3) Manual bypass of SRM.

Request full credit for 3 or 4 correct answers

Response: Additional answers added to key. All correct answers required for full credit.

Question 2.5. a&b.

Facility Comment: The question is unfair as it requires the candidate to memorize relay numbers.

Response: Required key response is too detailed. Parts a and b of this question have been deleted.

Question 2.5c

Facility Comment: Operators are not required to memorize 480V distribution.

Response: Operators should recognize which bus supplies the shutdown cooling system. If asked the operator should be able to draw a one line diagram of the 480V distribution system that serves the engineered safety features equipment.

Question 2.7.b

Facility Comment: Operators should not be required to memorize steps in an operating procedure. Also, first part of answer should be "yes".

Response: See response to Sorensen letter Attachment 2. The key for the first part of the answer was changed to "yes".

Question 2.8b

Facility Comment: Time delay should not be required. Also, TSW pump selected for auto start will come on after the diesel has powered the bus on loss of offsite power.

Response: Key changed to remove time delay and add additional correct answer. All three answers required for full credit.

Section 3

Question 3.1b

Facility Comment: Answer in key is true only for a "hardware failure".

Otherwise, during its normal function, no alarms are operable.

Response: Alarms are for abnormal conditions like hardware failure.

It's true they will not be in the alarmed condition

during the normal function of the RWM. No change to key.

Ouestion 3.3a and b

Facility Comment: Question unfair, MOB's are covered in requalification

training not as part of hot license training.

Response: Question 3.3a has been deleted. The part b is a systems

question. The candidates should know why the temperatures

are monitored even if they had not read the MOB's.

Question 3.6.a

Facility Comment: This question is not realistic. Operators do not

memorize FIS switch numbers.

Response: The question stated that it was the flow indicating

switch for the RCIC pump. The number was provided, but was not necessary. However, since this question asks for

more detail than normally asked, it has been deleted.

Question 3.6b

Facility Comment: Part b, should also accept "all located on flow

elbows inside drywell"

Response: Partial credit will be given for "all located on flow

elbows inside drywell".

Section 4

Question 4.1

Facility Comment: Question weighted to heavily for a single paragraph

out of one operating procedure.

Response: Examiner disagrees with facility comment. No change

to answer key.

Question 4.2

Facility Comment: This procedure is not used for operation of the RWM.

The volume 7 surv. procedure is used to verify RWM operability and to operate that piece of equipment. Does not assess the operators knowledge of system operation. It checks which lights come on or off.

Rote memorization of procedure not required.

Response: See response to Sorensen letter.

Question 4.5a

Facility Comment: Only answer 1 if found in the abnormal procedures

listed in the reference. #2 is not ever applicable, #3

and #4 are the same thing and they result from #1.

Response: The key has been changed to delete #3. #4 is

acceptable only if there is no turbine trip.

Question 4.5b

Facility Comment: This is okay if #1 only is accepted. On a turbine

trip, you don't worry about this because a loss of F.W.

heating occurs with every turbine trip.

Response: With the changes to 4.5a, no change to 4.5b is necessary.

Question 4.6

Facility Comment: This question requires total recall of procedure.

Response: See response to Sorenson letter.

Ouestion 4.12b

Facility Comment: This can easily be confused with the licensed operator

requirement of T.S. 6.2.2.d which requires an SRO for core alterations. Should give credit for a true answer

as well.

Response: A "true" answer is acceptable, if the T.S. is

referenced.

SRO EXAM

Section 5.

No additional facility comments.

Section 6.

Question 6.2.b

Facility Comment: Throw out-not relevant

Response:

See response to Sorensen letter.

Question 6.3.b

Facility Comment: Too detailed, throw out.

Response:

Key answer too detailed. Changed to accept a description that it is a centrifugal device used

to actuate the trip lever or some similar

statement.

Question 6.4.a

Facility Comment: Add "all 7 ADS valves" to key.

Response:

Since there are 14 switches, answering "all 7 ADS

valves" is not specific enough.

Question 6.4.b

Facility Comment:

Use of the word "normal" is misleading - would never push ADS pushbuttons under normal conditions - may

have confused some people.

Response:

If it appears the use of the word "normal" confused a candidate, consideration will be given in the grading.

Question 6.5.c

Facility Comment:

Throw out-too much detail-candidate not required to

know all power supplies by memory.

Response:

ES-402-A.2 states "Candidate should be able to

reproduce from memory...electrical distribution system."

Also see response to Quesiton 2.5c.

Question 6.7.a

Facility Comment: Also withdraw block, RWM Block (possibly-not always).

Response: The answer key will be changed to add withdrawal block,

but not RWM block.

Question 6.7b

Facility Comment: "Or bypassing on RSCS." Also may say to bypass RWM.

Response: Answer key changed to include "bypassing on RSCS".

Question 7.3.a

Facility Comment: Answer should be generalized to simply say strip bus,

energize bus, reload bus. The present answer requires

memorization of operating procedures.

Response: The answer key has been changed to remove panel and

breaker numbers as required for full credit. However,

more description is required than proposed by the

facility. See response to Sorensen letter.

Question 7.4

Facility Comment: There are more than 1400 Annunciator procedures. Two

points is too great of importance to place on one of

them. Please consider reducing point value.

Response: The correct answer is a logical response to any

annunciator that has upscale and down scale alarms and is applicable to many annunicators, especially alarms for monitors that measure radiation and could

indicate a possible excessive radiation level or

effluent release. Memorization of 1400

annunicator procedures is not required. Also see response to Sorensen letter. Answer key revised to

remove numbers from the required answer.

Question 7.5.b

Facility Comment: Requires total recall of operating procedures. Also

the evolution is only for startup after complete drain

down and is done very seldom.

Response: This question requires system knowledge expected of

an SRO candidate. However, since this is done very

seldom, this part of question was deleted.

Question 7.6

Facility Comment: Procedure is wrong - Tech. Specs. require RWM-RSCS to be

operable prior to decreasing below 20%.

Response: Examiner disagrees with facility comment. Surveillance

is required to be performed within one hour after RWM auto-initiation when reducing thermal power (WNP-2,

T.S; 4.1.4.1.c, 3/4 1-16). No change to answer key.

Question 7.8

Facility Comment: Question requires total recall; doubtful anyone will

get right. Please consider point values.

Response: The question includes information that an SRO is expected

to know, but to confirm by checking the Tech. Specs.

Question has been deleted.

Question 8.2.a

Facility Comment: Answer "a" gives only the action statement for the

LCO. Credit should also be given for explanation of why the candidate believes his answer to be as he indicated. If you wanted the action statement, it

should have been asked for.

Comment: Credit will be given for reasonable explanations

as to why the Tech. Specs. require the candidate

to take action.

Question 8.9

Facility Comment: This is an unfair question!

Initial training does not necessarily incorporate MOB training into it. Without the benefit of reading the MOB, the chances of candidates getting the correct answer is minimal! Additionally, part a and c are more of a system oriented question than admin., etc., and

should not be part of category 8.

Response: Part b has been deleted. Parts a and c require systems

knowledge. The candidates should be able to answer the questions without reading the MOB. No change to

parts a and c.

Question 8.10

Facility Comment: Memorization of EPIP 13.1.1 is not feasible. While

the majority of the symptomatic conditions which call for event classification are well known, the situational based events are much more vague. I cannot imagine any operator declaring an emergency events

without reference to EOP's ro EPIP's for guidance.

Response: SRO candidates are expected to have knowledge of both

symptomatic-based condition and situation-based conditions which call for event classification. However, we agree that they would be expected to check the EOP's or EPIP's prior to making an

emergency event declaration.

Response to Facility Comments Provided in Sorensen Letter

RO Exam

Question 2.5

Parts a) and b) are deleted, however, the operator should recognize which bus supplies the shutdown cooling system. If asked, the operator should be able to draw a one line diagram of the electrical distribution system for all engineered safety features equipment.

Question 2.7

The question asks about a specific valve by functional name and number. This is an important component in an important system. An operator should know the location relative to the pump (upstream or downstream). The point of the questions is whether the operator knows to close the valve to prevent a possible water hammer due to voids in the line. This is a fair question for several systems.

Memorization of a specific valve number or specific steps in the normal operating procedure is not required. Most of the credit will be for knowing about preventing water hammer.

Question 3.9

NUREG-1021, ES-202 B.3 states in part, "The candidate should have sufficient knowledge of the nuclear..., the process..., and radiological instrument (e.g., ionization, G-M, and scintillation), to answer questions concerning principles of detector operations, location and setpoints...." The question asked for types of detectors for radiological instruments (e.g., scintillation, ion chamber, fission chamber or Geiger Mueller) for specific processes. This is clearly within the scope of ES-202 B.3.

Question 4.2

The question asks for the operator to have knowledge of how the test/select and inop/reset push buttons work. He does not have to have the procedure memorized. Since these are controls available for the operator he should have knowledge of what happens when he operates them.

Question 4.5

Step by step memorization of the procedure is not required. The information requested is only part of the steps of the procedure. The intent of the question is to determine the level of awareness of the operator to control room indications. The operator should know that there are alarms associated with energizing an important safety bus (the exact name of the alarm is not required). Also, the operator should be aware of what voltage readings are available and the availability and meaning of control board indicating lights. These things are expected to be within the knowledge of the operator.

Question 4.12

NUREG-1021, ES-202 B.4 states that administrative procedures, including operating restrictions, limitations in the facility license and technical specifications may be included to the extent they are directly applicable to an operator. The number of operators required in the control room and on the refueling floor is directly applicable to the operator. He is expected to know the administrative requirements applicable to his job position.

SRO Exam

Question 6.2

As stated in response to Question 3.9, types of detectors are expected knowledge for RO and SRO candidates. Also, logic systems that control radiation releases are very important to know so the SRO can understand and diagnose abnormal system behavior. If this information is not covered in the candidate training program, there is a serious gap in the program which can not only lead to failures on the NRC examination, but much worse, the candidate may pass the NRC examination and become a licensed operator not fully trained to perform the job and thereby, become a potential part of an excessive radiological release.

Question 7.3

All that is required for the answer is that the candidate know in general what needs to be done to accomplish the operation of tieing the 250V battery B2-1 to the DC distribution bus S2-1. A step by step response is not required for full credit.

Question 7.4

The responses asked for do not require the procedure to be memorized. The question specifies the things the operator must do (i.e., verification and check). The candidate should have knowledge of which system and components are associated with an alarm, their general location (i.e., control room, local) and the safety significance.

Question 7.8

This question asks for more detail than normally required. The question has been deleted.

Question 8.2

The candidate should have thorough knowledge of what is addressed in the Technical Specification and should know whether actions are required with the Division 1 250V battery discharged.

The part b of the question requires the candidate to memorize the surveillance requirements for the 250 volt battery, thus beyond the scope of the examination as defined by ES-402, A.4. Part b of the question has been deleted.

Question on placing RCIC Controller in Manual (Question 8.6 b)

The question refers to the limitations in SOP 2.4.6, Reactor Core Isolation System. In this context, only the additional answer "When, in the operator's judgement, continued automatic operation is undesirable (Ref: PPM 1.3.1, Att 1, Item 3)" is applicable. This additional answer will be allowed if the standing order is referenced. The additional answer has been added to the answer key.

Simulator Exam Scenarios

In order to provide each candidate with one or more malfunction to respond to during each scenario, unrelated malfunctions were selected. This, however, is not that much different from some operating events. We have had plant events that have had several unrelated malfunctions. (e.g., Trojan had a diesel driven auxiliary feedwater pump, a turbine driven auxiliary feed, an emergency diesel generator and the main steam isolation valves all malfunction in one event.)

There were several events in each scenario, but in most cases the operator was allowed to deal with each event prior to the initiation of the next event. It is not rare to have 6 to 10 malfunction during the operation of a power plant. Operators must learn to be aware of which systems are operating and thereby, be able to perform there normal evolutions efficiently and safely.

General 'Comments

- 1. Need specific examples of which questions were unclear and how prior exam review could have made them more clear. Also which questions used unfamiliar terminology and what terminology should have been used.
- 2. Sometimes the examiner must answer in this manner when a direct response to the candidate's question would provide an answer to the exam question. In these cases, we generally request the candidate to provide as much information as he can and qualify the response with any assumptions that were made. This will give the candidate the best opportunity to get full credit for the response.
- 3. There are no questions that request an open ended discussion. All questions can be answered with a short response. Typically the question asks for a response and then asks "why" or "explain choice" or the question will set the conditions and then state "briefly explain what happens." The questions that are vague and open ended should be specified.
- 4. Except for the questions that were deleted, both examinations were within the scope of topics listed in the 10 CFR 55 and Exam standard NUREG-1021. Presently 10 CFR 55 and NUREG-1021 are the standard used to define the scope of the examinations. If the training objectives for the WNP operator training program are not consistent with these standards, the training objectives should be redefined. We have not written our examinations to fall within the WNP training program training objectives nor have we written our examination to be consistent with the Job Task Analysis (JTA) for RO/SRO personnel. The NRC has a very active program which includes industry participation to evaluate exam questions. Our

goal is to be able to use JTA to evaluate the importance and applicability of examination questions to RO/SRO job performance. We hope that in the near future all of our examinations will contain questions that have been evaluated based on JTA. We do not expect this to result in any significant changes in the scope of the examination, but will result in assigning question values that are more consistent with the importance of the required knowledge to the performance of the job.

MASTER

U. S. NUCLEAR REGULATORY COMMISSION REACTOR OPERATOR LICENSE EXAMINATION

			Facility	:_WNP-Z
			Reactor '	Type: BWR-5
			Date Admi	inistered: 11/6/84
			Examiner	I. S. Levy
			Candidate	91
INSTRUCTIO	ONS TO C	ANDIDATE:		
Staple quare indicat least	estion stated in 70% in 6	sheet on top parenthesis a each category	of the answer fter the ques and a final o	Write answers on one side only. sheet Points for each question stion. The passing grade requires grade of at least 80%. Examination the examination starts.
Category Value			% of Cat. Value	Category
25				1. Principles of Nuclear Power Plant Operation, Thermodynamics Heat Transfer and Fluid Flow
25	25			2. Plant Design Including Safety and Emergency Systems
25	-25			3. Instruments and Controls
25	25	-		4. Procedures: Normal, Abnormal, Emergency, and Radiological Control
100				TOTALS
		Final Grade	8	
All work d	ione on t	this examinati	on is my own;	I have neither given nor received

Candidate's Signature

Questions and Answers to WNP-2 RO Exam - 11/6/84

1.0 Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow (25.0)

- 1.1 Regarding a Reactor Startup:
 - a. Does the magnitude of the initial level of source range counts affect the Estimated Critical Position? Why? (1.25)
 - b. How long will it take to reach 0.08% power, if the reactor is just critical at 0.002% power and on a steady period with a "doubling time" of 40 seconds? (Show all work.) (1.0)
- 1.1 a. No (0.5). Initial count rate does not affect the amount of reactivity required to go critical, which determines ECP (0.75). [The higher the initial count rate, the higher the count rate when criticality is reached.] (1.25)

Ref: WNP-2 Reactor Theory, pg. 29 and 43.

b.
$$P = PO e^{(t/T)}$$

 $T = 40 / (ln2) = 57.71 sec^{-1}$ (0.5)
 $t = 57.71 (ln(P/PO)) = 212.88 sec (0.5)$ (1.0)

Ref: WNP-2 Reactor Theory, pg. 61.

1.2 With regard to some aspects of Fission Product Poisons:

a. Of the two fission product poisons Xe and Sm, give two (2) reasons why xenon is more troublesome. (1.5)

b. What is the mechanism(s) for removal of Samarium-149 once it is produced in the core? (1.0)

1.2 a. (1) Because of its exceptionally large thermal neutron absorption cross-section (0.75); (2) its concentration varies with reactor power level and/or time (0.75); (3) Xe produced assembly for the foreign.

b. Sm-149 is removed only by burnout (1.0)

Ref: WNP-2 Reactor Theory, pp. 83 and 87, respectively.

When control rod density in the core decreases at higher 1.3 burnups (from pulling rods) the void coefficient of reactivity becomes more or less (choose one) negative? Why? (1.5)

Less (0.5). Since local steam voids cause an increase in thermal diffusion length (0.5), control rods, which absorb thermal neutrons, make the steam void reactivity coefficient more negative (0.5) [Therefore, reduced control rod density causes the void coefficient to be less negative.]

(1.5)

Ref: WNP-2 Reactor Theory, pp. 98-99.

: .

1.4 The effective decay constant for up power transients will be higher or lower (choose one) compared to its value for down power transients. Give the reason for your answer.

(1.5)

1.4 Higher (0.5). For up power transients the short lived precursors are dominant due to the addition of power (0.5), while for down power transients the long lived precursors dominate the decay constant (0.5)

(1.5)

Ref: WNP-2 Reactor Theory, pg. 54.

1.5 Following a scram from high power, answer the following:

a.	What are the most reactive regions of the core?	(1.0)
b.	Why are these regions more reactive?	(1.25)
c.	What problem does this cause for the operator during a subsequent start up. Why?	(1.25)

1.5 a. Near the edges and at the top and extreme bottom

b. Xe concentrates, during power operation, where power is highest, i.e., in the center and near the bottom of the core (0.75), where it acts as a poison, adding negative reactivity (0.50)

c. Operator must be extremely cautious while pulling edge and top rods (0.5) since normally low worth rods now have excessively high incremental worths (0.75)

Ref: WNP-2 Lesson Plan, Figure 4-12.

(1.0)

(1.0)

(1.0)

(1.0)

(1.0)

(1.25)

(1.25)

1.6 Give four (4) inputs or outputs for a reactor heat balance, stating whether it is an input or output and a brief description as to why it is.

(3.0)

1.6 (any 4 @ 0.75 each)

(3.0)

- a. Feedwater flow heat input (0.25) going into the vessel (or system) with positive enthalpy (0.5).
- b. Steam flow heat output (0.25) due to steam removing energy from the core (0.5).
- c. Recirc pump heat input (0.25) due to energy added to the fluid in the core (or system) by the pumps (0.5)
- d. CRD flow heat input (0.25) due to fluid flowing into the core (or system) with a positive enthalpy (0.5).
- e. Rx core thermal energy heat input (0.25) due to being primary source of heat input (0.5).
- f. any other reasonable answer such as RWCU inputs/outputs, etc.

Ref: MTC; Thermo/HT/FF (3/83), pp. 8-50.

1.7 Following initial criticality (MSIVs closed, moderator T > 212°F), a constant positive period is established.

Briefly explain what happens over the next several hours to pressure, temperature and power if no rod movement occurs. (1.5)

1.7 Power initially increases but levels off due to negative reactivity insertion resulting from increasing moderator temperature (0.5). Pressure and temperature initially increase but level off when power levels off then reduces due to ambient losses (0.5). The reduced T causes the cycle to start again so that long term power, pressure and temperature will oscillate around point of adding heat (0.5).

(1.5)

Ref: Standard Reactor Theory.

1.8 What are two (2) reasons a centrifugal pump should be started with the discharge piping filled and the discharge valve shut?

(1.0)

1.8 Water hammer and excessive starting current.
Ref: Morris T.C.; Thermo/HT/Fluid Flow (3/83), pg. 7-123.

(1.0)

1.9 a. Assume the reactor is at 100% power and flow. Explain what happens to core flow, and why, for a reduction in power by driving rods in. (Recirculation pump speed remains constant.)

b. At low power conditions prior to void generation, an increase in reactor power by control rod withdrawal will (increase, decrease, not change) flow through the core.

Choose the correct answer and explain your choice.

1.5)

9- low pare cach up to 35.7 Express 2 floregumes.

- Week one he year near ?

1.5)

- 1.9 a. Core flow would increase (0.5) due to a reduction in two phase flow condition (and, therefore, in the core less resistance to flow) (0.75). (1.25)
 - b. Increase (0.5). Flow resistance in the channels drops due to decreased liquid viscosity with temperature (0.5); and greater density differences between warm channels and cool downcomer will increase flow due to increased thermal driving load causing greater natural circulation (0.5) (1.5)

Ref: Morris T.C.; Thermo/HT/Fluid Flow (3/83), pg. 9-51.

- 1.10 There are several characteristic transients that would be limiting because of MCPR.
 - a. List any two (2) of these transients. (0.75)
 - b. Assuming for each of the transients in (a) they occurred at 100% power, EOC and full rod out conditions, give:
 - the most important reactivity ccoefficient involved. (0.5)
 - 2. What occurred in the reactor and why it occurred to affect this coefficient. (0.5)

- 1.10 Any 2 of following. pts: a) 0.375 each; b) (1) 0.25 each; (2) 0.25 each (1.75)
 - Generator load reject w/o bypass; void coefficient, void collapse from pressure increase
 - Turbine trip w/o bypass; void coefficient, void collapse from pressure increase
 - Loss of feedwater heating, void coefficient, void collapse from subcooling
 - Inadvertent start of HPCS pump; void coefficient, void collapse from subcooling
 - Feedwater controlling failure high; void coefficient, void collapse from subcooling

Ref: Morris T.C.; Thermo/HT/Fluid Flow (3/85), pg. 9-94 through 9-96.

1.11 Given:

Rx pressure at time T = 675.3 psig
Rx pressure at time T + 1 hr = 215.3 psig

a. What is the Rx cool down rate for this hour? Show all calculations. (0.75)

b. Is this rate acceptable at your plant? (0.5)

1.11 a. (Because the reactor operates at saturated conditions the temperature for time T and T + 1 hr can be found using the steam tables.)

1) Saturation temperature for 690 psia is approximately 502°F.
Saturation temperature for 230 psia is approximately 394°F. (0.375)

2) Cool down rate = $(502^{\circ}F - 394^{\circ}F)/1$ hr. Cool down rate = $108^{\circ}F/1$ hr. (0.375)

b. No. (The cool down rate limit is 100°F per hour.) (0.5)

Ref: Steam Tables and WNP-2 Tech. Specs.

1.12 Answer TRUE or FALSE for each of the following:

a. As water flows around a bend in a pipe, the velocity of the water is uniform throughout the diameter of the pipe. (0.5)

 The pressure in a static fluid always <u>decreases</u> with <u>increasing</u> elevation of the measurement. (0.5)

1.12 a. False (0.5) b. True (0.5)

Ref: General Fluid Dynamics Text.

1.13	Will an increase in the following factors (taken separately) increase, decrease, or not change differential rod worth?									
	a. thermal diffusion length									
	b. neutron flux at the rod									
	c. core average neutron flux									

1.13 a. increase b. increase c. decrease (0.5)

$$\alpha_D = -1 \times 10^{-5} \frac{\Delta K}{K}$$
°F

$$\alpha_v = -1 \times 10^{-3} \frac{\Delta K/Z}{K}$$
 voids

$$c_{\rm H} = -4.5 \times 10^{-6} \frac{\Delta K/Z^*F}{K}$$

$$\Delta \rho = f \frac{L_{\rho V^2}}{D_{2g_c}}$$

$$\rho = \frac{k(eff) - 1}{K(eff)}$$

$$\frac{1}{m} = \frac{CR1}{CR2} = \frac{1 - K(eff)2}{1 - K(eff)1}$$

$$M = 1/(1-k)$$

$$N(t) = No e^{-\lambda T}$$

$$n = v/(1+d)$$

17.58 watts = 1 BTU/min

lpsi = 6.895 Pa

lpsi = 2.036 - Hg (@ OC) lpsi = 27.68 - H²O (@ 4C)

B = .0071

1 = 2 x 10-5 sec

Table 1	Caturated !	Steem.	Tamperature	Table

	Abs Press	Spe	cific Value	me				Entropy		-	
femp fahr t	Sq in	Sat Liquid	Evap	Sat. Vapor Vg	Sat. Liquid	Even	Sat. Vapor	Sal Liquid S ₁	Evan	Sat Vagor S g	Fahr t
32.6°	0 08859 0 09600 0 10395 0 11239	0 016022 0 016021 0 016020 0 016019	3304 7 3061 9 2839 0 2634 1	3304 7 3061 9 2639 0 2634 2	-00179 1996 4008 6018	1075 5 1074 4 1073 2 1072 1	1075 5 1076 4 1077 2 1078 1	0 0000 0 0041 0 0081 0 0122	2 1873 2 1762 2 1651 2 1541	2 1807 2 1807 2 1732 2 1663	32 8 34 6 38 6 36 6
44.8 47.8 44.0 48.0	013133 013133 014197 015314 016514	0 016019 0 016019 0 016019 0 016020 0 016021	2445 8 2272 4 2112 8 1955 7 1830 0	2445.8 2277.4 2112.8 1965.7 1830.0	\$ 027 10 035 12 041 14 047 16 051	1071 0 1069 8 1068 7 1067 6 1066.4	1079 0 1079 9 1080 7 1081 6 1082 5	0 0162 0 0202 0 0212 0 0282 0 0321	2 1432 2 1325 2 1217 2 1111 2 1006	2 1594 2 1527 2 1459 2 1393 2 1327	42 8 44 8 46 8
58 6 57 8 54 8 56.8 56.8	0 17796 0 19165 0 20625 0 22153 0 23843	0 016023 0 016024 0 016025 0 016028 0 016031	1704 8 1589 2 1482 4 1383 6 1292 2	1704 8 1589 2 1482 4 1383 6 1292 2	18 054 20 057 22 058 24 059 26 060	1065.3 1064.2 1063.1 1061.9 1060.8	1084 2 1084 2 1085 1 1086 0 1086 9	0 0361 9 0400 9 0439 0 0478 0 0516	2 0901 2 0798 2 0695 2 0593 2 0491	2 1262 2 1197 2 1134 2 1970 2 1008	50 0 52 0 54 0 56 0 58 0
62 0 62 0 64 0 64 0	0 25611 0 27254 0 25497 0 31626 0 33889	0 015033 0 015036 0 015039 0 015043 0 015046	1207 6 1129 2 1056 5 989 0 975 5	1207 6 1129 2 1056 5 989 1 926 5	28.060 30.059 32.058 34.056 36.054	1059 7 1056 5 1057 4 1056 3 1055 2	1087 7 1088 6 1089 5 1090 4 1091 2	0 0555 0 0593 0 0532 0 0670 0 0708	2 0.391 2 0.291 2 0192 2 0094 1 9996	2 0946 2 0885 2 0824 2 0764 2 0704	62 5 62 5 64 5 64 6
78.8 77.0 74.0 76.0 76.0	0 36292 0 38514 0 41550 0 44420 0 47461	0 015050 0 015054 0 015058 0 015063 0 015067	8683 8143 7641 7174 6738	968 4 814 3 764 1 717 4 673 9	38 052 40 019 42 046 44 043 46 040	1054 0 1052 9 1051 8 1050 7 1049 5	1092 1 1093 0 1093 \$ 1094 7 1095 6	0 0745 0 0783 0 0821 0 0858 0 0895	1 9900 1 9874 1 9706 1 9614 1.9520	2 0645 2 0587 2 0529 2 0472 2 0415	70 0 72 0 74 0 78 0 78 0
M. 0 67 0 64 0 M. 0	0 50687 0 54093 0 57702 0 61518 0 65551	0 015072 0 015077 0 015082 0 015087 0 016093	623 3 595 5 560 3 527 5 496 8	633.3 595.5 560.3 527.5 496.8	48 037 50 033 52 029 54 026 56 022	1048 4 1047 3 1046 1 1045 0 1043 9	1096 4 1097 3 1098 2 1099 6 1099 9	0 0932 0 0969 0 1005 0 1043 0 1079	1 9426 1 9334 1 9242 1 9151 1 9060	2 0359 2 0303 2 0248 2 0193 2 01 39	92 9 94 9 96 9 96 9
98 0 97 0 94 5 96 0 96 0	0 69813 0 74313 0 79062 0 84073 0 89356	0016099 0016105 0016111 0016117 0016123	441 3 416 3 392 8 370 9	441 3 416 3 392 9 370 9	58 01 8 60 01 4 62 01 0 64 00 6 66 00 J	1041 6 1040 5 1039 3 1038 2	1100 8 1101 6 1102 5 1103 3 1104 2	0 1115 0 1152 0 1138 0 1224 0 1260	1 8970 1 5851 1 8792 1 8704 1 5617	2 0086 2 0033 1 9940 1 9478 1 9676	90 1 97 1 94 1 96 1
100 0 167 8 164 8 186 8	0 94924 1 00789 1 06965 1 1347 1 2030	0016130 0016137 0016144 0016151 0016158	350 4 331 1 313 1 296 16 280 28	350 4 331 1 313 1 296 18 280 30	67 999 69 995 71 992 73 99 75 98	1037 1 1035 9 1034 8 1033 6 1032 5	1105 I 1105 9 1106 8 1107 6 1108 5	0 1 295 0 1 331 0 1 366 0 1 402 0 1 437	1 8530 1 8444 1 6358 1 8273 1 8188	1 9575 1 9775 1 9775 1 9675 1 9675	100
110 6 112 6 114 6 116 8 118 8	1 2750 1 3505 1 4299 1 51 33 1 6009	0 015165 0 016173 0 016180 0 016188 0 016196	255 37 251 37 238 21 225 84 214 20	265 39 251 38 238 22 225 85 214 21	77 98 79 98 81 97 83 97 85 97	1031 4 1030 2 1029 1 1027 9 1026 8	1109 3 1110 2 1111 0 1111 9 1112 7	0 1472 0 1507 0 1542 0 1577 0 1611	1.8105 1.8021 1.7938 1.7856 1.7774	1 9577 1 9528 1 9480 1 9433	110 112 114 116
120.0 122.0 124.0 126.0 120.0	1 6927 1 7891 1 8901 1 9959 2.1068	0016204 0016213 0016221 0016229 0016238	203 25 192 94 183 23 174 08 165 45	793 26 192 95 183 24 174 09 165 47	87 97 89 96 91 96 93 96 95 96	1025 6 1024 5 1023 3 1022 2 1021 0	11136 11144 11153 11161	01646 01680 01715 01749 01783	1.7693 1.7613 1.7523 1.7453 1.7374	1 9386 1 9379 1 9293 1 9247 1 9202 1 9157	178: 178: 174: 174: 178: 178:
130 0 132 6 134 8 136 8 138 0	2 2230 2 3445 2 4717 2 6047 2 7438	0 016247 0 016256 0 016265 0 016274 0 016284	157 32 149 64 142 40 135 55 129 09	157 33 149 66 142 41 125 57 129 11	97 % 99 95 101 95 103 95 105 95	1019 8 1018 7 1017 5 1016 4 1015 2	1117 9 1118 6 1119 5 1120 3	0.1817 0.1851 0.1884 0.1918 0.1951	1.7795 1.7217 1.7140 1.7063 1.6986	1 9112 1 9768 1 9024 1 8980 1 8337	128 1 132 1 134 1 138 1 138 1
140 0 147 0 146 0 146 0	2 8892 3 0411 3 1997 3 3653 3 5381	0016293 0016303 0016312 0016327 0016332	122 94 117 21 111 74 106 58 101 68	123 00 117 22 111 76 106 59 101 70	107 95 109 95 111 95 113 95	1014 0 1012 9 1011 7 1010 5 1009 3	1127 0 1122 8 1123 6 1124 5 1125 3	0 1985 0 2018 0 2051 0 2054 0 2117	1 6910 1 6534 1 6759 1 5684 1 6610	1 8895 1 8552 1 8810 1 8769 1 8777	148 1
152 0 152 0 154 0 158 8 158 8	3 7154 3 9065 4 1025 4 3068 4 5197	0 016343 0 016353 0 016363 0 016364	97 05 92 66 89 50 84 54 80 82	97 07 92 68 68 52 84 57 80 83	117 % 119 % 121 % 123 %	1008 2 1007 0 1005 8 1004 6 1003 4	1126 1 1126 9 1127 7 1128 6 1129 4	0 2150 0 2183 0 2216 0 2228 0 2281	1 6536 1 6463 1 6390 1 6318 1 6245	1 8686 1 8606 1 8566 1 8526	198 8 152 8 154 6 156 8
160 0 162 0 164 0 166 0	4 7414 4 9772 5 2124 5 4423 5 7223	0 015395 0 015405 0 015417 0 015428 0 015440	77 27 73 90 70 70 67 67 64 78	77 25 73 92 70 72 67 68 64 80	127 96 129 96 131 96 133 97 135 97	1002 2 1001 0 999 8 998 6 997 4	1130 2 1131 0 1131 8 1132 6 1133 4	0 2313 0 2345 0 2377 0 2409 0 2441	1 6174 1 6103 1 6032 1 5961 1 5892	1 8487 1 8448 1 8409 1 8371 1 8333	160 0 167 0 164 0 166 0
176 0 177 0 174 6 176 0	5 9976 6 2736 6 5656 6 6090 7 ; 240	0016463 0016474 0016474 0016498	62 04 59 43 59 95 54 59 52 35	62 06 59 45 56 97 54 51 52 36	137 97 139 98 141 98 143 99 145 99	996 2 995 0 993 8 992 6 991 4	1134 2 1135 0 1135 8 1136 6 1137 4	0 24/3 0 2505 0 2537 0 2568 0 2600	1 5822 1 5753 1 5634 1 5616 1 5548	1 8795 1 8258 1 9221	178 8 172 8 174 6 176 6

Statement of the second

Table 1	Sanurated	Ctesm.	Termograture	Table	Cantinuad

Temp	Abs Press	Sat.	pecific V	Sat	Sat	Enthaig	Sat	Sar	Entropy	Sat	Iem
Fane	Sq in	Liquid	Evas	Asber	Liquid	Evap	Vapor	Liquid	Evap	14001	Fan
120 6 162 0 184 6 185 0	7 5110 7 850 8 203 8 368 8 967	0 016510 0 016527 0 016534 0 016534	48 17 36 23 46 38	50.77	148 00 150 01 152 01 154 02 156 03	990 2 989 0 987 8 986 5 985 3	1136 2 1139 0 1139 8	0 2631 0 2662 0 2694 0 2775 0 2756	1 5480 1 5413 1 5346 1 5279 1 5213	1 8111 1 8075 1 8040 1 8004 1 7969	180 6 182 5 194 8 196 8
196 0 192 8 194 0 196 0 198 0	9 340 9 727 10 168 10 605 11 058	0 016572 0 016545 0 016598 0 016611	40 94 39 33 37 804 36 344	40 957 39 354 37 874	158 05 160 05 162 05 164 06 166 08	984 1 982 8 981 5 980 4 979 1	1142 1 1142 9 1143 7 1144 4 1145 2	0 2787 0 2818 0 2848 0 2879 0 2910	1 5148 1 5082 1 5017 1 4952 1 4868	1 7934 1 7900 1 7865 1 7831 1 7798	198 6 192 6 194 6 198 6
200 0 204 0 208 0 212.6 216.0	11 526 12 512 13 568 14 696 15 901	0 01 56 37 0 01 56 64 0 01 66 91 0 01 67 19 0 01 67 47	31 135 28 862 26 782	31 151	168 09 172 11 176 14 180 17 184 20	977 9 975 4 977 5 970 3 967 8	11460 11475 11490 11505 11520	0 2940 0 3001 0 3061 0 3121 0 3181	1 4697 1 4571 1 4447 1 4323	1.752 1.7448 1.7637 1.7568 1.7505	706 6 704 6 258 0 212 8 216 0
770 0 774 0 778 0 7712 0 7712 0	17 186 18 556 20 015 21 567 23 216	0.016.775 0.016.805 0.016.834 0.016.864 0.016.895	21 529 20 056 18 701	20.073	188 23 192 27 196 31 200 35- 204 40	965 2 962 6 960 0 957 4 954 8	1153 4 1154 9 1156 J 1157 8 1159 2	0 3241 2 3 3 3 0 3 3 3 5 9 0 3 4 1 7 0 3 4 7 6	1 4201 1 4081 1 3961 1 3842 1 3725	1 7342 1 7250 1 7320 1 7350 1 7301	278 8 278 8 278 8 238 8 236 8
248.0 244.0 248.0 252.0 256.0	24 958 26 526 28 796 30 583 33 091	0.016926 0.016958 0.016990 0.017022 0.017055	15 243 14 264 1J 358	13 375	208 45 212 50 216 56 270 62 224 69	952 1 949 5 946 8 946 1 961 6	1160 6 1162 0 1163 4 1164 7 1166 1	0 3533 0 3591 0 3649 0 3706 0 3753	1 3509 1 3494 1 3379 1 3266 1 3154	1 7142 1 7085 1 7028 1 6972 1 6917	248.0 248.0 248.0 252.0 256.0
258.6 254.6 254.6 272.6 272.6	15 427 37 894 40 500 43 289 46 147	0 01 7089 0 01 7123 0 01 7157 0 01 7193 0 01 7228		11 042 10 375 9 755	228 75 232 83 236 91 240 99 245 08	938 6 935 9 933 1 930 3 927 5	1167 4 1168 7 1170 0 1171 3 1172 5	0 3819 0 3875 0 3932 0 3987 0 4963	1 3043 1 2933 1 2823 1 2715 1 2607	1 6852 1 6808 1 6755 1 6702 1 6650	254 0 254 0 258 6 272 0 276 6
788.0 784.0 788.0 787.0 797.0	49 200 52 414 55 795 59 350 63 084	0017264 001730 001734 001738 601741	8 627 8 1280 7 6634 7 2301 6.8259	8 1451	249 17 253 3 257 4 261 5 265 6	924 6 921 7 918 8 915 9 913 0	1173 8 1175 0 1176 2 1177 4 1178 6	0.4098 0.4154 0.4158 0.4263 0.4317	1 2501 1 2795 1 2790 1 2186 1 2082	165-3 16494 16-19 16400	298 8 284 8 292 6 794 8
700 8 704 6 708.0 512.0 216.0	67 005 71 119 75 433 79 953 94 668	0 01 745 0 01 749 0 01 753 0 01 757 0 01 761	6 4483 6 0955 5 7655 5 4566 5 1673	6 4658 6 1130 5 7830 5 4742 5 1849	269 7 273 5 278 0 282 1 286 3	901 0	1179 7 1180 9 1182 0 1183 1	0 4475 3 4479 0 4533	1877 LE 1.76 16 1675 16	6351 6303 6256 6209	300.6 384.6 708.6 217.5
120 0 124 6 128 0 132 0 134 0	89 643 94 826 100 245 105 907 111 820	0 01 766 0 01 770 0 01 774 0 01 779 0 01 783	4 8961 4 641 8 4 4030 4 1 /88 3 9681	4 9138 4 6595 4 4208 4 1366 3 9859	290 4 274 6 298 7 302 9 307 1	894 8 891 6 888 5 585 3	1185 2 1186 2 1187 2 1188 2 1189 1	0 4540 1 0 4697 1 0 4745 1 0 4798 1	1477 16 1378 16 1280 16 1183 15	6162 6116 6071 6025 981	378 8 374 8 328 8 337 0
140 0 144 0 152 0 156.0	117 992 124 430 131 142 138 138 145 424	0 01 787 0 01 792 0 01 797 0 01 801 0 01 806	3 7699 3 5834 3 4078 3 7473 3 0863	3 7878 3 6013 1 4256 3 2603 3 1044	311 3 315 5 319 7 323 9 328 1	878 8 875 5 872 2 868 9	1190 1 1191 0 1191 1 1192 7	0 4907 1 0 4954 1 0 5006 1 0 50°8 1	0990 15 0894 15 0799 15 0705 15	936 892 349 806 763 721	348 0 344 0 348 0 357 0
160 0 164 0 186 0 177 8 176.8	153 010 160 903 169 113 177 648 186 517	0 01811 0 01816 0 01821 0 01825 0 01831	2 9292 2 8002 2 6691 2 5451 2 4279	2 9573 2 8184 2 6873 2 5633 2 4462	332 3 336 5 340 8 345 0 349 3	862 1 858 6 855 1 851 6	1194 4 1195 2 1195 9 1196 7	05161 1 05212 1 05263 1 05314 1	0517 15 0424 15 0332 15 0240 15	678 637 595 554	350 0 364 0 364 0 364 0 377 0
50 0 50 0 30 0 92 0 96 0	195 729 205 294 215 270 225 516 236 193	001847 001853	2 31 70 2 2120 2 11.76 2 0184 1 9291	2 3353 2 2304 2 1311 2 0369 1 9477	353 6 357 9 362 2 366 5 370 8	844 5 840 8 837 2 633 4	198 0 198 7 199 1 199 9 200 4	05416 U 05466 0 05515 0 05567 0	0057 15 9946 15 9876 15 9786 15	192	376 0 386 0 384 0 388 0 392 0
00 0 04 0 00 0 17 0 16 0	247 259 258 725 270 600 282 894 295 617	001870 001875 001881	1 8444 1 7540 1 6877 1 6152 1 5463	1 95 30 1 78 77 1 70 54 1 63 40 1 36 51	375 379 4 383 8 388 392 5	825 9 1 827 0 1 818 2 1 814 2 1	201 0 201 5 201 9 202 4 202 8	0 5667 05 0 5717 05 0 5716 05	0607 152 9518 153 1429 151	774 J4 195	400 0 400 0 404 0 404 0 417 0
76 8 74 8 76 8 17 8 14 6	308 790 327 391 336 463 351 00 366 03	001906		1 4997 1 4374 1 3782 32179 26806	376 9 401 3 405 7 410 1 414 6	806 2 1 802 2 1 798 0 1 793 9 1	203 1 203 5 203 7 204 0 204 2	0 5915 0 0 0 5964 0 0 6014 0 0 0 6014 0 0 0 6014 0 0 0 6014 0 6014 0 60	165 150 1990 150 1993 149	180 147 104 66	478 8 478 8 478 8 478 8 437 8
M 0	381 54 297 56 414 09 421 14 448 73	001933 1 001940 1 001947 11	14878 10212 05764	21647 16806 12152 07711 03472	419 0 423 5 428 0 412 5 437 0	785 4 1. 781 1 1. 776 7 1.	704 4 704 6 704 7 704 8	06161 08 06210 08 06219 08	1816 49 1779 49 843 48 557 48 471 47	90	436 8 440 8 440 8 457 8

	405 P- #55	Table 1. Saturated Ste				Enthaig		Entropy			
fahr 1	Sq in	Sat Liquid	Evan	Vapor 5.11	Sul Liquid h,	Evan		Sat Ligurd		14001 14001	Fant
466 6 464 8 468 0 472 9 478 8	465 87 485 56 504 83 524 67 545 11	001961 001969 001976 001986 001992	0 97463 0 93586 0 89585 0 86345 0 82958	0 99424 0 95557 0 91862 0.88329 0 84450	441 5 446 1 450 7 455 2 459 9	763 2 754 6 754 0 749 3 746 5	1204 8 1204 7 1204 6 1204 5 1204 3	0 6405 0 6454 0 6502 0.6551 0 6599	08:27 08:27 08:27 08:27 07956	1 4704 1 4667 1 4629 1 4592 1 4555	468 6 464 6 468 6 477 8 477 8
486 6 484 8 486 8 492 8 492 8	546 15 587 81 610 10 633 03 656 61	0 02009 0 02009 0 02017 0 02025 9 02034	0.79716 0.75613 0.73641 0.70794 0.68065	0 81717 6.78622 0 75658 0.72820 0.70100	464 5 469 1 473 8 473 5 483 2	7396 7347 7297 7746 7195	1204 1 1203 8 1203 5 1203 1 1202 7	0 6648 0 6696 0 6793 0 6842	0 7871 0 7785 0 7700 0 7614 0 7528	1 4518 1 4481 1 4407 1 4370	484 0 484 0 483 0 497 0 497 0
300 0 204 5 508 0 517 0 516.0	680 86 705 78 731 40 757 72 784 76	0 02043 0 02053 0 02062 0 02072 0 02081	0 65448 0 62938 0 60530 0 58218 0 55997	0 67492 0 64991 0 62592 0 60289 0 58079	497 9 497 7 497 5 502 3 507 1	714 3 709 0 703 7 598 2 692 7	1202 2 1201 7 1201 1 1200 5 1199.8	0 6490 0 69 19 0 6987 0 7036 0 7685	0 7113 0 7357 0 7271 0 7135 0 7099	1 4333 1 4296 1 4258 1 4221 1 4183	500 0 504 0 500 0 512 0 516 0
529 0 524 0 528 0 532 0 533 0	812 53 841 04 870 31 900 34 931 17	0 02091 0 02102 0 02112 0 02123 0 02134	0 53864 0 51814 0 49843 0 47947 0 46123	0 55956 0 57916 0 51955 0 50070 0 48257	512 0 516 9 521 8 526 8 531 7	681 3 675 5 663 6 663 6	1199 0 1196 2 1197 3 1196 4 1195 4	0 7133 0 7182 0 7231 0 7280 0 7329	0 7013 0 6926 0 5839 0 6752 0 6665	1 41 46 1 41 08 1 40 70 1 40 32 1 399 3	529 0 524 0 528 0 537 0 538 0
548 8 548 8 548 8 552 8 556 8	962 79 995 22 1028 49 1062 59 1097 55	0 02146 0 02157 0 02169 0 02182 0 02194	0 44367 0 42577 0 41048 0 39479 0 3 756	0.46513 0.41834 0.41717 0.41660 0.40160	536 8 541 8 546 9 552 0 557 2	657 5 651 3 645 0 638 5 632 0	1194 3 1193 1 1191 9 1190 6 1190 2	0 7378 0 7427 0 7476 0 7525 0 7575	0 6577 0 6489 0 5400 0 6311 0 6222	1 3954 1 3915 1 3876 1 3837 1 3797	546 8 544 8 544 2 552 8 558 8
568 0 564 0 568 0 572 0 578 0	1133 38 1170 10 1207 72 1246 26 1285 74	0.02207 0.02221 0.02235 0.02249 0.02264	0 36507 0 35039 0 33741 0 32429 0 31162	0 38714 0 37320 0 35975 0 34678 0 33426	967 4 967 6 977 9 978 3 983 7	625 3 616 5 611 5 604 5 597 2	1187 7 1196 1 1154 5 1182 7 1180 9	0 7625 0 7674 0 7725 0 7775 0 7825	0 6132 0 6041 0 5950 0 5859 0 5766	1 3757 1 3716 1 3675 1 3634 1 3592	560.0 564.0 572.0 576.0
534 0 564 0 582 8 562 8 562 8	1326 17 1367 7 14100 1453 3 1667 8	0 02279 0 02295 0 02311 0 02329 0.02345	0 29937 9 29753 0.27608 0 25499 0 25425	0 32216 0 31048 0 29919 0 28827 0 27770	589 594 6 600 605 7 611 4	589 9 582 4 574 7 566 8 558 8	1179 0 1176 9 1174 8 1172 6 1170 2	0 7876 0 7927 0 7978 0 8030 0 8082	0.5673 0.5580 0.5485 0.5390 0.5293	1 3550 1 3507 1 3464 1 3470 1 3375	584 6 584 6 582 6 592 6 596 8
100 0 104 0 103 0 117 0 116 0	1543 2 1549 7 1637 3 1686 1 1735 9	0.07364 0.07382 0.07402 0.07402 0.07444	0 24384 0 23374 0 22394 0 21442 0 20516	0 26747 0 25757 0 24796 0 23865 0 22960	6171 6229 6288 6348 6408	550 6 542 2 533 6 524 7 515 6	1167 7 1165 1 1162 4 1159 5	0 8134 0 8137 0 82-0 0 8294 0 8343	05196 05097 04997 04996	1320 2254 3238 3190	600 8 504 0 606 0 617 8
170 0 121 0 128 0 132 8 136 8	1786 9 1839 0 1892 4 1947 0 2002 8	0 02539 0 02539 0 02566	0 19515 0 18737 0 17#80 0 17044 0 16226	0.22091 0.21225 0.20394 0.1953 0.18792	646 9 653 : 659 5 665 9 672 6	505 3 196 6 486 7 476 4 465 /	1153 2 1149 8 1146 1 1142 2 1133 1	0 8403 0 8458 0 8514 0 8571	04794 04583 04543 04474 04364	1 3141 1 3092 1 3041 1 2588 1 2934	676 6 674 6 678 6 677 6
44 0 42 0 52 8 16 0	2059 9 2118 J 2178 L 2239 2 2361 7	0 02595 0 02525 0 02557 0 02591 0 02728	015427 014544 013875 013124 012387	018021 017259 016534 015816 015115	679 1 685 9 692 9 700 0 707 4	454 6 443 1 431 1 412 7 405 7	1113 7 1129 0 1124 0 411# 7	0 8686 0 5746 0 8806 0 8868	04134 04015 03893 03767	1 2879 1 2821 1 2761 1 2699 1 2634 1 2567	536 6 546 0 544 0 540 0 552 0
64 0 64 0 77 0 76.6	2365 7 2431 1 2498 1 2566 6 2636 8	0.02911	011663 010947 010229 009514 008799	0 14471 0.13757 0.13087 0.12424 0.11759	7149 7729 7315 7402 7462	792 1 377 7 362 1 345 7	1107 0 1100 6 1093 5 1085 9 1077 6	0.8995 0.9064 0.9137 0.9212	0 3502 0 3361 0 3210 0 3054	1 2498 1 2425 1 2347 1 2756 1 2179	556 8 564 8 668 8 677 8
# 6 # 6 # 6	2708 6 2782 ! 2857 4 2934 5 301 3 4	0 03114 0 03204 0 03313	0 08080 0 07349 0 06595 0 05797 0 04916	0 7 0 046.3 0 097.94 0 091.10 0 08371	758 5 768 2 778 8 790 5 804 4	310 1 290 2 268 2 243 1	1068 5 1058 4 1047 0 1033 6 1017 2	0 9365 0 9447 0 9535 0 9634	0.2770 0.2537 0.2337 0.2337	2086 1994 1872 1744 1591	676 6 684 6 684 6 672 8
8 6 7 6 4 6 5 6 5 67*	3094 3 3135 5 3177 2 3198 3 3208 2	0 03424 0 04108 0 04427	0 03857 9 03173 9 02192 0 01304 0 00000	2 07519 0 06997 0 06300 0 05730 0 05078	827 4 635 0 654 2 873 0 706 0	172 7 144 7 102 0 61 4 00	999 2 979 7 956 2 934 4 906 0	0 9901 0 1 0006 0 1 0169 0 1 03.79 0	1490 1 11:36 1 108/6 1 1052; 1	1290 1252 1246 0856 0612	700 0 707 0 707 0 784 0 705 0 785 47

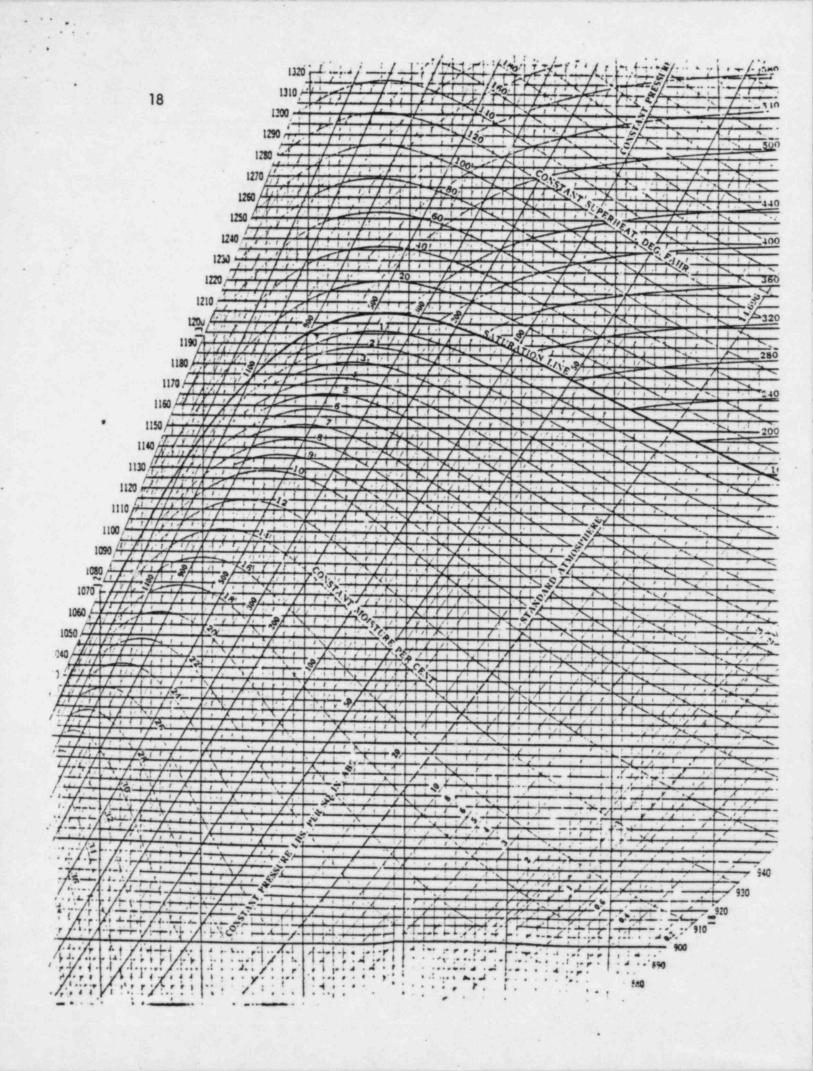
4 A.F. 444

weren.

		Sp	ecitic Value	me		Enthalgy		·	Entropy	Sat	Abs Press
Lb. Sq in	Fahr f	Fidniq A.	Evan *'s	Sat Vapor VE	Sat Liquid h j	Evap h ₁₆	Sat Vapor ng	Sat Liquid S.	tva0	13001	Lt Sq in
6 05963 6 25 9 36 1 8 3 8 10 0 14 696 13.6	17 018 59 123 79 586 101 74 162 74 193 21 112 00 213 03	0 016022 0 016032 0 016071 0 016136 0 016407 0 016592 0 016726	3,02 4 12,35 5 641 5 233 59 71 515 18 404 26 782 26 274	1302 4 1235 5 641 5 313 60 73 512 18 420 36 799 26 290	0 0003 27 382 47 623 59 73 130 20 161 26 160 17 181 21	1075 5 1060 1 1048 6 1036 1 1000 9 962 1 970 3 969 7	1075 5 1087 4 1096 3 1105 8 1131 1 1143 3 1150 5 1150 9	0 0000 0 0542 0 0925 0 1326 0 2349 0 2836 0 3121 0 3137	2 1872 2 0425 1 9446 1 8455 1 6094 1 5013 1 4447	18/7 03/0 9:81 6-1 73-9 73-64	0 04465 0 25 0 50 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1
71 21 41 41 41 41 41 41 41 41 41 41 41 41 41	27 96 250 14 257 25 281 02 292 71 302 93 112 04 120 28	0 015834 0 017009 0 017151 0 017273 0 017383 0 017482 0 017573 0 017659	20 070 13 7256 10 4794 8 4967 7 1562 6 1875 5 4536 4 8779	26 087 13 :436 10 4965 8 5140 7 1736 6 2050 5 4/11 4 8953	196 27 218 9 236 1 250 2 262 2 272 7 252 1 290 7	950 1 945 2 933 6 973 9 915 4 907 3 900 9 894 6	1156 3 1164 1 1169 8 1174 1 1177 6 1180 6 1181 1 1185 3	0 1358 0 2582 0 3921 0 1112 0 1112 0 1111 0 4534 0 4643	13942 1313 1314 1314 1314 1314 1305 1675 1470	17379 14995 15765 16586 15440 16316 16208	20 0 30 0 46 0 56 0 66 0 70 0 88 0 98 0
100 0 118.2 720 0 120 0 120 0 140 0 158 0 104 0 138 0	327 82 334 79 341 27 347 33 353 04 355 43 361 55 368 42 377 08 377 53	0 01/740 0 01/82 0 01/89 0 01:96 0 01803 0 01809 0 01815 0 01827 0 01833	4 4133 4 0306 3 7097 3 4364x 3 2010 2 9952 2 8155 2 6556 2 5129 2 3847	4 4310 4 0484 3.7275 3 6544 3 7190 3 0139 2 83,36 2 6738 2 5312 2 4030	298 5 305 8 31.2 6 319 0 325 0 336 1 341 2 346 2 350 9	888 6 883 1 877 8 872 8 868 0 863 4 859 0 854 8 850 7 946 7	1187 2 1183 9 1190 4 1191 7 1193 0 1194 1 1195 1 1196 0 1196 9	0 4743 0 4834 0 4919 0 5976 0 5071 0 5141 0 5176 0 5334	1 1:34 1 1115 1 0950 1 0815 1 0631 1 0954 1 0435 1 0322 1 0215 1 0113	1 5027 1 3350 1 5879 1 5813 1 5737 1 5695 1 5641 1 5591 1 5543 1 5498	128 8 110 0 129 8 138 9 148 0 159 0 162 8 178 0 198 0
210 0 210 0 220 0 220 0 230 0 250 0 250 0 250 0 270 0 290 0	381 80 355 91 355 98 359 88 359 70 397 39 400 97 404 44 407 80 411 07 414 25	0 01839 0 01844 0 01850 0 01855 0 01865 0 01865 0 01870 0 01870 0 01885	2 2689 2 16373 2 06779 1 97991 1 87909 1 82452 1 75548 1 69137 1 63169 1 57597	2 2873 2 18217 2 08629 1 99846 1 91769 1 84317 1 77618 1 71013 1 65049 1 59482	- 355 5 359 9 364 2 368 3 372 3 176 1 379 9 213 6 387 1 390 6	847 8 839 1 835 4 931 8 828 4 825 0 821 6 818 3 815 1	1198 3 1199 6 1200 1 1200 6 1201 5 1201 9 1202 3 1202 6	0 5438 0 5490 0 5588 0 5634 0 5679 0 5722 0 5764 0 5864	1 0015 0 9923 0 9934 0 9665 3 9565 0 9433 0 9341 0 9291	1 5254 1 5374 1 5336 1 5299 1 5264 1 5230 1 5197 1 5166 1 5135	200 0 210 0 210 6 210 6 240 0 250 0 250 0 250 0 250 0 250 0
254 0 254 0 490 0	41/ 25	0 01489 0 01912 0 01934	1 52384 1 30642 1 14162	1 54274 1 27554 1 16095	394 0 409 8 424 2	408 9 794 2 780 4	1202 9 1204 0 1204 6	0 5882 0 6059 0 6217	0 9777 0 8909 0 8630	1 5105	300 0 350 0 400 0
650 0 150 0 150 0 600 0 650 0 700.0	456 28 467 01 476 94 486 20 494 39 50J 08	0 01954 0 01975 0 01974 0 02013 0 02032 0 02050	1 01:224 0 90787 0 82183 0 74962 0 68811 0 63505	1 031 79 0 92762 0 84177 0 76975 0 70843 0 65556	417 1 449 5 460 9 471 7 481 9	767 5 755 1 743 3 732 0 700 9 710 2	1204 8 1204 7 1204 1 1203 7 1202 8 1201 8	0 6360 0 6490 0 6611 0 6723 0 6878 0 6978	0 9378 0 81+8 0 7925 0 7738 0 7552 0 7377	1 4738 1 4639 1 3547 1 4461 1 4381 1 4304	456 0 500 0 556 0 608 0 636 0 706 6
758 8 868 3 656 9 908 8 958 9 1100 8 1100 8 1158 8 1158 8	510 84 518 21 525 24 531 95 538 39 544 58 550 51 556 28 561 82 567 19	0 02009 0 02087 0 02105 0 02123 0 02141 0 02159 0 02177 0 02195 0 02214	0 58880 0 51809 0 51197 0 4 7968 0 45064 0 45064 0 40047 0 37863 0 35859 0 34013	0 50949 0 56896 0 53302 0 50091 0 47705 0 44596 0 47774 0 40058 0 36073 0 36245	500 9 509 8 518 4 526 7 534 7 542 6 550 1 557 5 564 8 571 9	699 8 689 6 679 5 669 7 660 0 550 4 640 7 531 5 627 2 813 0	1200 7 1199 4 1198 0 1196 4 1194 7 1192 9 1191 0 1189 1 1187 0 1184 8	0 7022 0 71:11 0 7197 0 7279 0 7358 0 7414 0 7507 0 7578 0 7647 0 7714	0 7219 0 7051 0 6899 0 6 753 0 6612 0 6216 0 6216 0 6216 0 6291	1 4732 1 4103 1 4096 1 4096 1 3970 1 3970 1 3851 1 3734 1 3734 1 3643	758 8 800 9 858 8 958 6 958 0 1058 0 1058 6 1158 8 1158 8 1758 8
1 750 0 1 750 0 1 750 0 1 450 0 1 450 0 1 550 0 1 550 0 1 550 0 1 650 0 1 750 0	572 38 577 42 542 32 587 07 591 70 596 70 300 59 504 87 609 05 613 13	0 02750 0 02269 0 02307 0 02307 0 02346 C 02166 C 02167 0 02407 0 02407	0 32306 0 30722 0 29250 0 27871 0 26584 0 25372 0 28235 0 23159 0 22143 0 21178	0 34556 0 32791 0 31537 0 30178 0 28911 0 27719 0 26601 2 25545 0 24551 0 23607	573 8 585 6 592 3 598 8 605 J 611 7 618 0 621 2 636 5	563 8 594 6 585 4 576 5 567 4 558 4 549 4 540 3 531 3 522 2	1182 6 1180 2 1177 8 1175 3 1177 8 1170 1 1167 4 1164 5 1164 6	0 7780 0 7843 0 7706 0 7766 0 8025 0 8025 0 8142 0 8199 0 8254 0 8199	0 5850 0 5773 0 5620 0 5507 0 5288 0 5182 0 5075 0 4857	1 3630 1 3577 1 3525 1 2474 1 2421 1 3271 1 3274 1 3275 1 3176	1750 0 1700 0 1750 0 1450 0 1450 0 1552 0 1600 0 1700 0 1700 0
1 790 0 1 800 0 1 850 0 1 850 0 1 950 0 1 950 0 2 7500 0 2 7500 0 2 7500 0 2 7500 0 2 7500 0	617 12 621 02 624 83 618 56 612 22 635 80 642 76 649 45 655 89 662 11	0 024/2 0 024/2 0 021/5 0 025/1 0 025/4 0 025/5 0 025/5 0 027/27 0 027/50	0 20253 0 14390 0 18558 0 17761 0 16999 0 16256 6 1485 0 13603 0 12406 0 11287	0 22713 0 21861 0 21052 0 20528 0 19540 0 18631 0 16272 0 15133 0 14076	642 5 628 5 654 5 660 4 666 1 677 1 641 8 695 5 707 2 719 0	\$131 \$038 \$916 4852 4748 4467 4467 4467 4460 3848	1155 6 1152 J 1149 0 1145 6 1142 0 1138 J 1130 5 1122 2 1113 2 1103 7	0 8163 0 9417 0 9470 0 8573 0 9573 0 7575 0 7477 0 7679 0 9979	0 1/65 0 1/65 0 1/64 0 1/64 0 1/64 0 1/64 0 1/64 0 1/64 0 1/64 0 1/64	11.78 10.4 10.90 1941 1751 1740 1756 1756 1756	1750 0 1600 0 1850 0 1950 0 1950 0 2000 0 2100 0 2100 0 2100 0
2500 Q 7500 A 2700 G 2700 G 2700 C 2700 C 2700 C 2700 C 2700 C 2700 C	668 11 673 91 679 53 684 96 690 27 695 33 700 28 705 08 705 47	0 02859 0 02938 0 03029 0 03134 0 03262 0 03473 0 04472 0 05078	0 10209 0 09172 0 08165 0 07171 0 06158 0 05073 0 03771 0 01191	012768 012110 011194 010305 009420 008500 007452 005663 005078	731 7 734 5 757 3 770 7 785 1 801 8 82 2 0 875 5 906 0	3616 33/6 3123 2951 2547 2183 1693 561	1093 3 1087 0 1069 / 1055 8 1039 8 1070 3 1933 3 1011 6 906 0	0 91 39 0 92 17 0 94 64 0 94 64 0 95 88 0 97 23 0 991 1 1 0 3 5 1 1 0 6 1 2	0 1206 0 1977 0 1241 0 1491 0 1215 0 1891 0 1450 0 0 1462 0 0000	1 7 3 4 5 1 7 5 7 1 7 6 7 1 7 6 7 1 7 6 7 1 8 7 7 1 1 7 7 1 7 7 7 1 7 7 7 1 7 7 7 7	2500 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0

*Critical pressure

w



2.0 Plant Design, Including Safety and Emergency Systems (25.0)

2.1 With regard to the Diesel Generators:

- a. The "Emergency Bypass-Test" selector switch is in
 "Emergency Bypass" position when a low reactor water
 level initiation signal is received. Which diesel
 generator trips would still be operable?
- b. Which of these trips would be bypassed if the selector switch was in the "Test" position and the same initiation signal was received? (0.5)

(2.0)

- 2.1 a. (all 4, 0.5 each) 1. Engine overspeed (2.0)
 - 2. Generator differential relay
 - 3. Fail to start (incomplete response)
 - 4. Emergency stop pushbutton
 - b. None (0.5)

Ref: WNP-2 System and Procedures; DG, pg. 33-35.

2.2 What safety action(s) are auto-initiated at each of the following indications:

a.	Level 4 (31.5")?	(0.5
b.	Level 2 (-50")?	(0.5
c.	1135 psig?	(0.5
d.	1076 psig?	(0.5

2.2 a. Runback recirc. flow if only 1 reactor feed pump.

(0.5)

b. Initiate RCIC and HPCS; trip recirc. pump; initiate

NSSS iso. groups 1, 2, 3, 4 and 7 (Equipment, in leased groups), (0.5)

account of all summer in the samps assume; if not, since orinjected

c. ATWS trip of recirc. pumps.

(0.5)

d. 2) MSL S/R valves open (relief mode).

Ref: WNP-2 System and Procedures; NBI, pg. 55 and 57;

Main Steam, pg. 32.

(7) Initiate RCIC and HPCS; trip recirc. pump; initiate

(0.5)

(0.5)

(0.5)

2.3 With respect to the Automatic Depressurization System (ADS):

a.	<u>List (including setpoints)</u> the automatic activation sequence for ADS.	(1.5)
b.	Which initiation signal(s) can be cleared by pressing a Seal-In Reset pushbutton(s)?	(1.0)
c.	Which of the signal(s) in (b) can be cleared only if the initiating condition no longer exists?	(0.5)

2.3 a. 1. Hi drywell pressure (>1.65 psig)
2. Lo water level (level 3: __50") +/3 "
3. Lo water level (level 1: -129") (0.3)(0.3)(0.3)4. 105 second timer timed out (0.3)5. ≥ 1 low pressure ECCS pump (125 psig for RHR/LPCI; 145 psig for LPCS). (0.3)b. 0.5 pts each (1.0) 1. ADS A(B) reactor pressure vessel low level logic Hi drywell pressure A(B) c. Hi dryweil pressure (0.5)Ref: WNP-2 System and Procedures; AOS, pg. 8-10; 12; and 12, respectively; + NB 1855.

2.4 With regard to the Reactor Protection System:

a.	Whic	h trip(s) can only be bypassed manually?	(1.25
b.	With	regard to the backup scram valves:	
	1.	Are they solenoid or air operated?	(0.5
	2.	To cause a scram, do they: (a) energize or (b) deenergize (if solenoid) (c) pressurize or (d) vent (if air operated) (choose only I answer)	(0.5)
	3.	What is their function?	. (0.5)

2.4 a (0.417 each) 0.21

1. APRM Hi-Hi
2. APRM inop.
3. Scram discharge volume Hi level trip
b. 1. solenoid
2. energize (a)
3. Spleed air from scram valves (vent header to atmosphere)
(0.5)
Ref: WNP-2 System and Procedures; RPS, pg 15, 15, 16; and 30-31, respectively.

2.5 With regard to the AC Electrical Distribution System:

sources for SM-4?

a. Which lockout relay will be tripped upon a Transformer

Differential Current (87TM)? (0.5)

b. List three (3) actions which will occur when the lockout relay in (a) is tripped? (1.5)

c. The loss of which 480V MC bus will deactivate both loops of shutdown cooling? (0.5)

d. What happens upon the loss of the normal and startup

(0.75)

Notregid for credit: 2.5 a. Unit lockout (86XU)) (0.5)b. any 3, 0.5 pts each (1.5). Trins and locks-out all "N" breakers • Trips 4F circuit breaken EGenerator Exciter Field Breaker E Trips main turbine (20 AST) De-energizes 86XIU Starts oscillograph · Starts computer c. MC-8-B-A () (0.5)d. automatic transfer of SM-4/to the Division 3 EDG (0.75)Ref: WNP-2 System and Procedures; AC Distr.; pg. 15 and 16 for a, b, d; AOP 4.7.1.9, Loss of Power to SM-8, pg 3 of 4 for c. close all 5 heatern Trups and beks - out 500 to heaters

Delete 2 \$b. " " main generator

Remarks gen ground protection

Locks met systete full heale

Blocks " " breaker Try ann uncesta

2.6 Concerning the Standby Liquid Control System (SLC):

a. Give three (3) of the four automatic actions which occur when the SLC System Control Switch is placed in the "Sys A" position? (1.0)

b. What is the purpose behind the SLC storage tank heater? (1.0)

c. There is a SLC pump trip on low flow (TRUE or FALSE)? (0.5)

2.6 (any 3, 0.33 each)

a. 1. Both SLC squib-valves fire.
2. RWCU-V-4 isolates.
3. Both SLC storage tank outlet valves open.
4. SLC-P-1A starts (if at least one suction valve is open).

b. Maintains solution temperature high enough to prevent precipitation of the sodium pentaborate.

(1.0)

c. False

(0.5)

Ref: WNP-2 System and Procedures, SLC; pg. 9, 13, 10, respectively.

2.7 Answer the following questions concerning the Low Pressure Core Spray System (LPCS):

of the LPCS-V-5 injection valve?

a.	What is the rated flow of the main LPCS pump?	(0.75)
b.	In shutting down LPCS to standby readiness, is the injection shut off valve (LPCS-V-5) closed before	
	stopping the LPCS pump (Yes or No)? Why?	(1.25)
c.	The check valve located inside the drywell is motor-operated (Yes or No)?	(0.5)
d.	What are the interlocks associated with the auto opening	

not regid for credit even though "rated in hy defentions for centifyed primpage whe for this.

a. 6350 gpm (at 128 psid reactor to suppression chamber.) 2.7 (0.75)

b. No (0.5); to ensure no voids are left in the discharge line which wouldcause water hammer upon subsequent pump restart (0.75) (1.25)

c. No (0.5)

(No undervoltage on SM-7 and reactor pressure <470 psig. (0.75)

Ref: WNP-2 System and Procedures, LPCS; pg. 8, 11-12, 5, and 7, respectively.

prostor should broke relative to pump Heed to know how to prevent uster homes. weed not know procedure step of valve numbers.

(0.75)

2.8	With	regard	to	the	Plant	Service	Water	System	(TSW)	
-----	------	--------	----	-----	-------	---------	-------	--------	-------	--

a.	what is the purpose of the Chlorine System?	(1.0)
b.	What causes starting of the TBCCW pumps and opening of discharge valves?	(1.5)
c.	Since TSW provides cooling only to non-essential equipment, why must the plant be shutdown when neither TSW pump can be started?	(0.75)
	pump out be started:	(0.75)

2.8 a. To inject chlorine to retard the growth of algae within TSW systems. "Forward growth of organics" also accepted (1.0)

all 3 regimed (6.5 arch)

b. A Pumps start on low pressure (<80 psig) on alternate pump or undervoltage on SM 85 (75) for 15 sec (0.75);

discharge valve opens when pump starts if control switch in auto (0.75); Task pump selected must be true to the first description of the secondary and primary plant. (1.5)

c. Because components cooled by TSW are essential for continued operation of the secondary and primary plant. (0.75)

Ref: WNP-2 System and Procedures, TSW; pg. 3, 4, 7, respectively.

- 2.9 Concerning the <u>CRD Hydraulic System</u>, give the appropriate values for the following:
 - a. Insert drive water pressure at 400 psig reactor pressure. (0.5)
 - b. Cooling water pressure at 400 psig reactor pressure. (0.5)

2.9 A. Rx + 260 = 660 psig (0.5) 2. Rx + 20 = 420 psig (0.5)

Ref: WNP-2 System and Procecures; CRDH; pg. 2.

2.10 Concerning the Condensate Storage and Transfer System (CSTS):

a. What is the minimum level that must be maintained in CST tanks at all times? (0.5)

b. Why is this minimum level required? (1.0)

2.10 a. 135,000 gal 16'8"} (0.5)

b. To provide suction for RCIC and HPCS systems to ensure immediate availability of sufficient condensate for ECCS and shutdown (1.0)

Ref: WNP-2 System and Procedures, CSTS; pg. 1 and 13.

3.0 Instruments and Controls (25.0)

3.1 With regard to the Rod Worth Minimizer System (RWM):

a.	Under what two (2) conditions will the Select Error alarm light be lit?	(1.0)
b.	Above LPAP, what alarms remain operative?	(1.5)

c. TRUE or FALSE: A rod block is applied upon the second insertion error. (0.5)

3.1 a. Whenever a selected control rod is not in the currently latched group (0.5) or one currently positioned so as to cause a withdraw or insert error (0.5) (1.0)
b. Inop/Reset; Withdraw block; Insert block (1.5)
c. False (0.5)
Ref: WNP-2, System Description, RWM, pp. 18, 20, 18, respectively.

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3.2 For the events listed, match the action(s) that will occur in the Recirculation System. Assume that the pumps are running in high speed. (An action may be used more than once)

(2.5)

Events:

1. Suction or discharge valves <90% open
2. Vessel hi presssure (ATWS)
3. Feedflow <30% with FCV <18% open
4. Reactor vessel low level (Level 3)

5. RPT

Actions:

a. Fast Speed Trip

b. Slow Speed Trip

c. LFMG start.

3.2 (0.5) each 1. A, B 2. A, B 3. A, C 4. A, C 5. A, C Ref: WNP-2, RRC, pg. 39.

(2.5)

3.3 According to Monthly Operational Bulletins:

Lette

How did the failure, on two shifts, to check chart movement on wetwell level recorder SMS-LR/RR-4 contribute to loss of wetwell level?

(1.0)

b. Why is it important to ensure that <u>local</u> temperature indicators at the <u>nitrogen</u> supply shed and in the reactor building are monitored?

(1.0)

3.3 delete The recorder had been, in fact, inadvertently de-energized so that annunciator alarm switches activated by the recorder pen were also 0.0.S.

-(1.0)

b. No control room monitors exist. If nitrogen temperature gets too low, nitrogen flow onto a 30 in. dia. containment purge header and onto wetwell and drywell purge liner inside containment could cause failure through nitrogen embrittlement.

(1.0)

Ref: WNP-2 Monthly OP Bull: April-May, pg. 1; Feb-Mar, pg. 6, respectively.

3.4 In reference to the Source Range Monitors (SRM):

a. What two (2) types of radiation are separated by the pulse height discriminator (PHD)? Which one causes an output signal from the PHD? (1.0)

b. Indicate (by Yes or No) whether the following trip circuits in the SRM electrical circuitry will generate a signal for use in the RMCS rod block circuitry:

(3.0)

1. Downscale

2. Retract Permit

3. Upscale High

4. Upscale High High (shorting links installed)

5. Incp.

6. Reactor period.

3.4 a. Neutron and gamma radiation (0.5); neutrons cause output (0.5) (1.0)

b. (0.5) each

(3.0)

1. Yes

2. Yes

3. Yes

4. No

5. Yes

6. No

Ref: WNP-2, System Description, IRM, pg. 14 and 28, respectively.

3.5	With	regard	to	the	Reactor	Manual	Control	System	(RMCS)	:

a.	The accumulation light starts <u>flashing</u> : 1. What is the cause(s) of this? 2. What causes the light changing to "steady on"?	(1.5)
b.	In mode 5 under what conditions, and in what manner will Sele	ct /1 5

c. Can an overtravel alarm be received if the control rod is connected to its drive unit (Yes or No)? (0.5)

(1.5)

3.5 a. 1. High-level (5 cc) or low No pressure (970 psig) (0.75)
2. Operator acknowledges alarm with "Accumulation Trouble Acknowledge" pushbutton (0.75)

b. Any rod is not fully inserted (0.75); SELECT BLOCK amber light (0.75)

c. No.

Ref: WNP-2, System Description, RMCS, pp. 7, 11, and 18, respectively.

3.6 With regard to the RCIC system:

delete	a.	RCIC pump flow indicator RCIC-FIS-2 has two contacts. What is the purpose of each contact?	12.0)
	b.	For monitoring steam flow to the RCIC turbine:	
		 How many differential pressure switches (DPS) are used to monitor steamflow? 	(0.5)
		2. Where are they located?	(0.75)
	c.	Should the RCIC-V-8 and RCIC-V-63 keylocked control switches be left in OPEN or CLOSED position when resetting any isolation signal?	(0.5)

3.6		1.	on high flow to send a signal to close the minimum flow bypass valve (RCIC-V-19) (1.0) and	
deleto	L	2.	on low flow with high discharge pressure (RCIC-PS-20) to open RCIC-V-19 (1.0)	-(2.0)
	b.	1.	4	(0.5)
		2.	2 - downstream of inboard steam isolation valve (RCIC-V-63) (0.375); 2 - downstream of the branch line to the RHR (0.375) (questated for the deposition of the line (a.25) field breated on flowellows made hyper ")	(0.75)
	c.	Open	Closed	(0.5)
	Ref	WNP.	-2, System Description, RCIC, pp. 27, 27; and SOP 2.4.6, 2 of 29, respectively.	

- 3.7 Concerning vessel instrumentation, state whether the following are TRUE or FALSE:
 - a. The Fuel Zone Range level indicators are calibrated cold. (0.5)
 - b. Level 1 (-128") will initiate NSSSS isolation groups:
 1, 2, 3, 4, and 7.
 (0.5)
 - c. The reference leg design of the Level Indicators have been designed to compensate for extreme temperature transients. (0.5)
 - d. Jet pumps 5, 10, 15, and 20 were individually flow calibrated prior to installation. (0.5)
 - e. Pressure measured at the core inlet plenum is also used as input to the CRDH system. (0.5)

- 3.7 (0.5) each (2.5)
 - a. False
 - b. False
 - c. False
 - d. True
 - e. False

Ref: WNP-2, System Description, NBI, pp. 57, 56, 5, 7, and 33, respectively.

- 3.8 With regard to the Power Range Neutron Monitoring System (PRMS):
 - a. What four (4) subsystems make up the PRMS? (0.75)
 - b. Which three (3) trips are input to RPS from the PRMS? (0.75)
 - c. For what two (2) conditions and for which components do the white indicators next to the heat flux meters below the full core display become lit? (0.75)

3.8 a. RBM, Flow Unit System, APRM, LPRM

b. APRM upscale thermal, APRM upscale neutron, inop.

(0.75)

c. Failed (0.25) bypassed conditions from LPRMs associated with rod selected (0.25). and agan hyperal (arr)

Ref: WNP-2, System Description: LPRM, pg. 1; APRM, pg. 36; LPRM, pg. 4; respectively.

ar APRM .66 Wp +42 mean late upward

11 70 mean late upward

15.71 mean lotte upward

module under late are separated.

Are module under late are separated.

3.9 Which type of detector (scintillation, ion chamber, fission chamber or Geiger Mueller) is used in the following process radiation measurements?

a.	Main steam line	. (0.5)
b.	Off-gas post-treatment	(0.5)
C .	Reactor building main exhaust	(0.5)
	Redecor buriding main exhaust	(0.5)

3.9 a. Ion chamber (0.5)
b. Geiger-Mueller (0.5)
c. Gieger-Mueller (0.5)
Ref: WNP-2 Syst. Descript., PRM, pg. 4, 3, 4, respectively.

Section points removed

3.3 a -1.0

3.6 a -2.0

-3.0 = 22.0 mentolel

- 4.0 Procedures Normal, Abnormal, Emergency and Radiological Control (25.0)
- 4.1 With regard to General Operating Procedure 3.1.2, Reactor Plant Cold Startup:
 - a. What $\frac{action(s)}{pump}$ should the operator take to prevent RWCU (1.0)
 - b. Why should you avoid heat-up rates that demand a high reject temperature . (1.0)
 - c. How will RPV water level stability be indicated? (1.0)

4.1 a. By adjusting reject valves RWCU-V-31 and V-33 as required. (1.0)
b. This will cause high RWCU F/D inlet temperatures and RWCU F/D isolation at 140°F. (1.0)
c. By a small output signal on the RFW-FCU-10 controller. (1.0)
Ref: WNP-2 PPM 3.1.2., pg. 8 of 18.

4.2 With regard to performing <u>Rod or Minimizer</u> (RWM) <u>initiation</u> in accordance with the System Operation Procedures for RWM (2.1.4):

a. How does the operator verify the RWM is not in "rod test"? (1.0)

b. What happens when the INOP/RESET pushbutton is depressed before the "System Initialize" pushbutton is depressed? (1.0)

c. What happens when the INOP/RESET pushbutton is depressed after the system is initialized? (1.0)

4.2 a. By depressing the TEST/SELECT button, observing illumination, depressing again and observing the light goes out. (1.0)
b. Any previous alarm ("Comp/Progam") is reset, the Comp light and the RWM/Program lights are illuminated. (1.0)
c. The RWM and program lights extinguish. (1.0)
Ref: WNP-2 SOP 2.1.4, pg. 2-3 of 3.

- 4.3 Relative to the Emergency Operating Procedure for RPV Pressure Control (RPV/P)(5.1.2):
 - a. List any three (3) of the five entry conditions. (1.5)
 - b. What are the four (4) systems to be used to augment the main turbine bypass valves for controlling pressure below 1075 psig? Give any limiting condition on the use of these systems. (3.0)

- 4.3 a. any 3; 0.5 points each (1.5)
 - 1) RPV water level below +13.0 in.

2) RPV pressure >1037 psig 3) Drywell pressure >1.68 p

3) Drywell pressure >1.68 psig4) A condition requiring MSIV isolation

- 5) A condition requiring reactor scram and power is above 5% or cannot be determined.
- b. (3.0)
 - 1) SRV's (0.6), if suppression pool water level >17 ft (0.3) 2) RCIC (0.6)
 - RWCU (recirculation through heat excharger and blowdown modes) (0.6); if no boron has been injected into RPV (0.3)

4) Main steam line drains (MS-V-16, -19, -21) (0.6)

Ref: WNP-2 EOP 5.1.2, pp. 1 and 6-7 of 8. Indreg'd frauent

- 4.4 a. The plant is in the process of starting up (Condition 2) with all systems and components normal except that the "A"

 IRM has previously failed high and was subsequently bypassad. The "E" IRM now loses power and is declared inoperative. May the plant continue in this condition for an extended period of time without being in violation of Tech. Specs? Also give the appropriate action statement. (1.5)
 - b. Could you place the mode switch in run (Condition 1) to bypass the action statement in part "A"? (0.5)

4.4 a. Yes (0.5); place the RPS A channel in the tripped position within one hour (1.0). (1.5)
b. NO (0.5). (0.5)

Ref: WNP-2 T/S, pp. 3/4 3-1; 3/4 0-1, respectively.

180055

Assuming a loss of feedwater heaters while operating at 100% power, according to Abnormal Operating Procedure 4.2.7.2:

a. Give three (3) of the four events that could have caused this? (2.25)

b. What change would you expect to see in the Main Generator MW (increase, decrease)? (0.5)

c. What is the first immediate operator action you should (0.75)

(Any 3 0 0.75 each) (1.125) (1.125) (1.125)
Correct auswers are land 2 or land 4 (1.125) 4.5 (2.25)1. Heater isolation on high water level. 2. Turbine trip. 3 (System malfunction resulting in the) isolation of or more feedwater heaters. 4. (System malfunction resulting in the) closure of extraction steam line valves for one or more feedwater heaters. (ok only of # 2 not given) Increase (0.5)c. Reduce reactor power via recirculation flow control

Ref: WNP-2 AOP 4.2.7.2, pg. 1 of 2.

(0.75)

37

4.6 With regard to the operating procedure for 250V DC

Distribution System (SOP 2.7.7), give any three (3) of
the four indications that the operator will have if the
tie to distribution bus S2-1 has been completed.

(2.25)

4.6 (Any 3 @ 0.75 each) Syack wording not required

(2.25)

- "250 VDC LOSS, BATT B2-1 FAIL" alarm on board "C" in Control Room clears.
- "250V VDC BATT B2-1 GND" alarm on board "C" remains cleared.
- 3. Bus S2-1 voltage reads 220 to 250V on board "C".
- 4. Bus S2-1 ground lamps on board "C" are on.

Ref: WNP-2 LSOP 2.7.7, pg. 2 of 5.

Presdure hemoresta not rold Expt nome of claim Delete Gueston. Youly worded. 4.7 Reactor coolant leakage into the primary containment from unidentified sources shall not exceed (1) gpm and the total coolant leakage shall not exceed (2) gpm. (1.0)

4.7 1. 5 gpm (0.5)

2. 25 gpm (0.5)

Ref: WNP-2 Tech Specs., pg. 3/4 4-9.

4.8 The Reactor Operator reports that "GEN BUS DUCT TEMP HIGH" and "GEN BUS DUCT CLR FLOW LOW" have activated and that bus duct temperatures are increasing. The failure of which component(s) is the most probable cause? (1.0)

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4.8 The TSW solenoid supply valve

Ref: WNP-2 AOP 4.5.6.1, pg. 2 of 2.

(1.0)

4.9 According to AOP 4.8.3.2 "Loss of all RCCW," if no RCCW pumps can be started during power operation, a rapid increase will occur in (Fill in). (0.5)

4.9 Drywell pressure

(0.5)

Ref: WNP-2 AOP 4.8.3.2, pg. 3 of 3.

4.10 According to the Abnormal Operation Procedures for Fires (4.12.4.1), one indication, other than fire alarm, will be fire header pressure fluctuation (TRUE or FALSE)?

(0.5)

4.10 True

(0.5)

Ref: WNP-2 AOP 4.12.4.1, pg. 1 of 2.

4.11 According to the Limitations stated in the Operating Procedures for the Reactor Core Isolation System (SOP 2.4.6), what must you do if manual isolation is required at any time that system initiation is not sealed in?

(0.75)

4.11 Close the isolation valves using their respective control switches.

(0.75)

Ref: WNP-2 SOP 2.4.6, pg. 2 of 28.

4.12 With regard to Administrative Procedures:

- a. There must be two (2) licensed operators in the Control Room at all times (TRUE or FALSE)? (0.5)
- b. During new fuel handling operations, a licensed operator must be on the refueling floor (TRUE or FALSE)? (0.5)

- 4.12 a. False (0.5)
 - b. False or TRUE if answer refused Tach Space. (0.5)

Ref: WNP-2 Admin. Proc: 1.3.2, pg. 3 and 6.2.3, pg. 2, respectively.

7.5. para 6.2.1.d for True

I disagree that "b' can be true. A SHO or BRO restricted to Refueling 25 regumed Not 2 Ro "e" is true if stated were and one sho. 4.13 According to Standing Order/Night Orders (Admin. Proced. 1.3.1), under what conditions can the reactor operator shut the reactor down without being instructed by the Shift Manager or required by the Emergency Procedures? (1.0)

4.13 When safety of reactor is in jeopardy or when operating parameters exceed any RPS setpoint and autoshutdown does not occur.

(1.0)

Ref: WNP-2 Admin. Proc. 1.3.1, pg. 2.

4.14 With regard to the <u>Health Physics Program</u>, what are the whole body exposure limits for the following:

(1.0)

- a. Administrative exposure limits (day, quarter, year)
- b. Lifesaving actions

1250 munity almosphate A APM 111.3 M30725

4.14 1. 300 mrem/day (0.17); 1000 mrem/quarter (0.17);

5000 mrem/year (0.16)

2. 75 rem (0.5)

(0.5)(1.0)

Ref: WNP-2 Health Physics Program, 3.1.5, pg. 4 of 5.

Master

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

			Facility:	WNP-2
			Reactor Type:	BWR5
			Date Administe	ered: 11/6/84
				I. S. Levy
			Candidate:	
INSTRUCTIO	NS TO CA	NDIDATE:		
Staple quare indica	estion s ated in	parenthesis af	ter the question	et. Points for each question. The passing grade requires of at least 80%. Examination examination starts.
Category Value	% of Total	Candidate's Score	% of Cat. Value	Category
	25			Theory of Nuclear Power Plant Operation, Fluids and Thermodynamics
25	25		6.	Plant System Design, Control and Instrumentation
23.5	24.87		7.	Procedures - Normal, Abnormal, Emergency, and Radiological Control
15	2122		8.	Administrative Procedures, Conditions, and Limitations
44.5				TOTALS
		Final Grade		
All work	done on	this examinati	ion is my own; I	have neither given nor received
			7	andidate's Signature

Questions and Answers to WNP-2 SRO Exam - 11/6/84

- 5.0 Theory of Nuclear Power Plant Operations, Fluids and Thermodynamics (25.0)
- 5.1 Give three (3) reasons why fuel densification is a problem. (2.25)

5.1 (any 3; 0.75 each)

(2.25)

- Local power spikes resulting from axial fuel column gaps.
- Increased linear heat generation rate due to pellet axial shrinkage.
- 3. Cladding collapse at the location of axial fuel column gaps.
- Increased stored energy due to decreased pellet-cladding thermal conductance resulting from increased radial gap size.

Ref: Morris Training Center: Thermo/HT/Fluid Flow (3/83), pg. 9-107

where 4 annuar engine, 0.5625 pseul.
Where 5 Duswors ere given, 22 = .45 each.

5.2	Your latest computer following values for			and MAPRAT sh	g: T.s "safts tent on
	Region	1	2	3	
	MFLPD	0.95	1.0	1.05	A Said Time
	MAPPRAT	0.92	1.08	1.00	want in your anich
	a. Which, if any, o				(1.0)
	b. Why are each of protect against?)			(1.5)
	c. Compared to BOL, larger or smalle	would the r? Why?	e values	for MAPRAT at I	EOL be (1.5)

5.2	a.	MFLPD Region 3 MAPRAT Region 2	(0.5) (0.5)
	b.	MFLPD - Maintains <1% cladding strain, fuel failure.	(0.75)
		MAPRAT - Maintains <2200°F following LOCA, decay heat removal	(0.75)
	с.	Larger (0.5); MAPLHGR limit decreases (0.5) since local peaking factor gets smaller as, with exposure, heat transfer is reduced (0.5).	(1.5)
	Ref		

In reference to the reactor water cleanup regenerative heat exchanger, assume the following conditions and, then, perform the calculations.

Conditions:

T inlet from reactor (tube side) = 550°F T outlet from H_X (tube side) = 250°F T inlet shell side = 120°F

Tubeside flow rate from reactor = 1300 gal/min Shellside flow rate to reactor = 1300 gal/min

Calculate (and show all work):

- The amount of heat transfer (Btu/hr) on the tube side. (1.0)
- The temperature of the water going back to the reactor. (1.0)
- The maximum temperature of water going back to the reactor if the flow back to the reactor were decreased 4. Of must me to cate mu dend seef due to lead.

 A so that important to home why

 decrease occur; only that at due occur. from 1,300 gpm to 800 gpm due to a leak in the tube side of the H.

5.3 a. Q = M x Cp x AT

= 1300 gal/min x 60 min/hr x 8.33 lbm/gal

x 1 Btu/1bm°F x (550-250)

c. 550°F as follows:

$$T_{max} = Q/M + 120$$

but cannot be greater than 550°F (max. T from reactor to inlet)

Ref: Morris, T. C.; Thermo/HT/Fluid Flow (3/83), pgs. 8-40,41.

5.4 While at 75% power, the master feedwater controller fails low. Will the NPSH of the recirculation pumps increase, decrease, or remain unchanged? Briefly, explain why.

(1.25)

5.4 Decrease (0.5); reduced subcooling (0.75)

(1.25)

Ref: Morris, T. C.; Thermo/HT/Fluid flow (3/83), pg. 7-96.

5.5 With regard to excess reactivity:

a.	reactor is greater than that for the hot, clean, zero power condition (TRUE or FALSE).	(0.5)
b.	The excess reactivity for the	

5.5 a. True

(0.5)

b. False

(0.5)

c. False (0.5); fuel depletion and fission products increase (0.75)

Ref: WNP-2, Reactor Theory Rev. pg. 39.

- 5.6 The WNP-2 reactor is taken to criticality from a cold condition and then placed on an 80 second positive period.
 - a. From control room <u>nuclear</u> instrumentation, how can the operator tell <u>when</u> the heating range has been reached? (Rod position and recirculation are held constant). (0.75)
 - b. In which of the following intervals was the heating range entered? Explain the reason for your answer. (Show all work.) (1.5)
 - Interval 1 reactor power increased by a factor of 6 in 143.3 seconds.
 - Interval 2 reactor power increased by a factor of 3 in 99.0 seconds
 - Interval 3 reactor power increased by a factor of 5 in 128.8 seconds.

(Note: the intervals may not be in sequence.)

5.6 a. Operator can notice that period has become longer, and that power change on IRMs is leveling off(*375)

b. (From P = Poet/T + T = t / In P/Po) Interval 2 (0.5);

the period has lengthened from 80 seconds. The other intervals have 80 second periods (1.0).

Ref: General control room indications; WNP-2, Reactor Theory, pg. 58.

5.7 With regard to Reactivity Coefficients: a. Which reactivity coefficient is the most dominant under the following conditions: (2.0)1) During rod drop accident at 15% power 2) Pulling rods at 1% power 3) MSIV closure at 100% power 4) Feedwater controller fails high at 100% power? b. For "feedwater controller fails high at 100% power," a.4) above: 1) Give the reason for your answer to a.4) above. (1.0)2) What will happen to power (increase, decrease, stay the same)? (0.5)3) What is the approximate value at BOL of the coefficient you gave as your answer to a.4) above? (0.5)5.7 a. (0.5 for each) (2.0)1) Doppler coefficient Moderator coefficient 3) Void coefficient 4) Void coefficient (0.33) b. 1) Increase in core subcooling which reduces void fraction whose coefficient has greatest effect on reactivity. 31 (1.0)2) Increase (0.5)gue credit for conent. 3) $-1 \times 10^{-3} \Delta K/K/1\%$ void change (0.5)

Ref: Standard Reactor Theory.

Near the end-of-cycle (EOC), will differential control rod worths near the bottom of the core be lower or higher than 5.8 those near the top of the core? Why? (1.75)

Higher (0.5). As fuel burns, control rods must be withdrawn causing flux to peak lower in the core (0.75); and rod worth is proportional to flux2 (0.5). Ref: WNP-2, Reactor Theory, pg. 81.

(1.75)

- 5.9 With regard to the effects of equilibrium Xenon and Samarium (the reactor has been operated at a constant power for many days):
 - a. If reactor power is then <u>doubled</u>, will the new equilibrium <u>Samarium</u> concentration be exactly <u>twice</u> as great (YES or NO)? <u>Explain</u>.
 - b. If the reactor is shut down, initially by a 1% ΔΚ/Κ, will the initial effect of Xenon be to increase or decrease the shutdown margin? (0.5)

(1.5)

5.9 a. No (0.5); the equilibrium value of samarium does not depend on flux, and, therefore, it does not depend on power level (1.0).

Ref: WNP-2 Reactor Theory, pg. 87.

b. Increase. (0.5)

Ref: Standard Reactor Theory

5.10 With regard to Delayed Neutrons:

- a. In causing fissions, what is the major difference between delayed neutrons and prompt neutrons? (0.75)b. Explain how and why the value of the delayed neutron fraction, Beta, changes from the beginning of core life to the end of core life. (0.75)
- c. Explain the effect on reactor control of the change in Beta with core life. (0.75)

5.10 a. Delayed neutrons have a lower probability of causing fast fission (the "importance" factor is less than 1). (0.75)

Ref: Standard Reactor Theory.

0.0056 gar WUP-2 Nevers b. Beta will decrease from about 0.007 at BOL to 0.0054 (0.375) at EOL due to buildup of Pu-239 and depletion of U-235(0.31) (0.75)

Ref: Standard Reactor Theory.

c. As beta decreases with core age, reactor period decreases and, therefore, for the same reactivity addition rate, a shorter period and less easy control is obtained at EOL. (0.75)

Ref: Standard Keactor Theory

$$\alpha_v = -1 \times 10^{-3} \frac{\Delta K/2}{K}$$
 voids

$$T\frac{1}{2} = \ln(2)/\lambda$$

$$\rho = \frac{k(eff) - 1}{K(eff)}$$

Table 1: Saturated Steam: Temperature Table

	-			Table 1	Satura	led Steam	: Tem	perature 1	able			
Color Colo			Saf	pecific Va		Sat	Enthalp		Sat	Entrep		feren
		p						V.spor	fieind		* agest	
	34 €	0.001110	0.014051	30019	3061 9	1 976	1074.4	1076 4	7 3/91	(a)	2.61	
1	18 8	011249	0 016019						0.00.41	2 1451		16.0
1	47 6	013133	1016019	27124	72724	10 035	1060 4	(0/93	0.0702	2 1 125	21527	
1	16.6	0 15314	9/01/4/970	17:57	1765 7	14 047	10676	1081 6	0.37.85	21111	2149	46.6
14 0 200-15 0 016-05 148-0 1				1704 8			1055 3	1087 4	0.0151	7 0901	2 1262	56.6
	16 8	0.20%25	0/016/7/8	1383 6	1383 6	27 058 24 059	10619	1086.0	0 0139	2 0595	21070	54 8
	44	0.25611	0 0 16033	1207 6	1207 6	29.050	1053.7					
All	64 8	0.29497	0.016/119	1056 5	1056 5	31058	10474	17895	0.0512	2 0291	2 0935	67 B
			0 016046	926.5	926 5	36 054	1055 2	1041 5	0.008	1 9396		
	72 B	0.41550	0 015-054	764 1	#14 3 764 1	4, 1749	1057 9	TIME TO	0 11/83	9804	2 1441	17.0
## 0 54071 0116077 596 5 595 5 0011 107 1	78.0	0 4/461					1050 7	10937	0:3954	1 9614	2.5472	76.6
### 0 055518	87 B	0 54091	0.014017	595 5	595 5	50.013	[34]	11997.7	0 10 14.0	19114	29191	
10		0.61518	0.0150A7	2275	4275	541124	1545 0	[reng	0 1743	19151	2 2131	16.0
Mail	17 6	0 /4 11 3	0 014105	441 3	4413	60.714	1041.5	11016		1 8970	7 0084	90.0
1886	#1	0 84072	0016117	397 8	192 9	64 006	10143	1:033	0 1224	18/92	19978	54 4 56 8
100/49 0016114 3111 111 111										,		
100/49 0016114 3111 111 111												
100/09			0/14130			67 999	(617)	1125.1	01/25	1 45 10	1 18/5	
1	184 8	1 06/145	0.016114	1111	113.1	71 1/32	:014.8	1106.8	01211	8358	1 9775	194 0
17.00	100.0	1 7010	0.016158	780 78	780 30	75 98	10325	11085	0 (417	8188	1 9626	
1986 1987 1988	117 8	1 1505	0.016171	251 17 218 21	251 38 218 22	81 37	10/02	11102	01507	1.8071	1 9528	117 8
177	178.8	I NAME	0.016134	714 2G	71421	85.97	1076 #	11177	015/7	1.7816	19413	116 6
178	127 8	1 /891	0.014513	197.94	197 95	87.76	10/4 5	11144	DRALD	17613	19771	122 6
1318			0 016779	1/4 08	17409	93 %	1027 2	11161	01749	1 7453	1 9202	175 6
198	132 8	2 3445	0.016256	149 64	149 66	99 95	10187			1 7295	19112	
146 2897	136 8	2 6047	0.016274	135 55	135 57	103 95	1016 4	11203	01918	7063	1 9024	134 8
144 8 3 1997 0016312 11174 11176 11199 13117 11226 07051 16759 1810 1448 1468 3 35538 0016322 10558 10559 11395 10105 11226 07084 15688 18769 1448 10170 11595 100073 11225 07084 15688 18769 1448 1877 1446 1888 3 3184 0016332 10168 10170 11595 100073 1125 3 071117 15610 18777 1446 1888 3 37184 0016333 9705 9707 11795 10002 1125 1 071117 15610 18777 1446 1888 3 37184 0016313 97065 9707 11795 10002 1126 1 07110 15610 18777 1446 1888 1888 1889 1885 1888 1895 10070 1126 9 07183 18463 18846 1828 1846 1828 1846 1828 1846 1828 1846 1828 1846 1828 1846 1828 1846 1828 1846 1848 1871 1848 1848 1846 1846	142 6	3 0411		122 98	173 00	107 95	10140	11220	0 1985	1 6910	1 8895	148.0
138	146 6	3 3653	0.016322	106 58	106 59	111 95	1010 5	11236	0.7051	16759	18810	144
154	150.0	3 7184		97.05	9707	117.95	1008 2	1126 1	0.2150	1 6516	1 8686	
164 8 4 /414 0616195 /7.77 77.79 127.76 1001 4 1127 4 0.2781 16245 1846 1848 1848 1848 1848 1848 1848 1848	156 6	4 1025 4 1068	0116374	84 56	84 57	171 95	1005 #	1126 9	0 7183	16463	18646	152 8
1878 49727 07154056 73 67 73 6					80 83	125 96	10014	1129.4	0.2781	1 6245	1 8576	158.8
188 57223 0016440 8478 64 80 135 97 998 1132 6 02409 15961 18321 1848 1788 59876 0016451 6204 62 006 137 97 998 2 1134 7 02441 15892 18333 1888 1788 6 6738 0016463 5943 5945 13898 01134 7 02473 15822 18333 1888 1788 6 6738 0016463 5943 5945 13898 01590 01250 02505 15752 18258 1788 1788 6 68700 0016464 56 95 56 97 14138 973 8 1135 8 02537 15848 18271 1748 1788 6 68700 0016476 5459 5461 14139 973 8 1135 8 02537 15848 18271 1748	164 8	5 2124	0.016417	1190	1917	131 76	977 6	1131 6	0:145	16103	1 8448	182 5
1728 67736 9016863 39.43 38.45 13.98 99.0 11350 92.907 15752 18258 1728 1848 53556 0216874 56.95 36.97 141.98 99.0 1135 9.2537 15884 1827 1748 1838 68500 99.0 1838 98.97 141.98 99.0 1356 92.57 15884 1827 1748	168.8	5 /223	0.016440	64 78		133 97			0.7409	1 5961	1 8371	166 8
178 6 8690 0715486 3459 3461 14359 9074 1356 07564 1677 1748	177 8	6 2 / 36	0.016463	5943	59.45	13998	495 0	11350	0.2505	1 5753	1 8758	177 8
	176 8	6 8690	0.016486	54 59	54.61	143 99	22 6 221 4	1136 6	0.7568 0.2600	15616	18184	116 6

*The viging shown are meta-stages

Temp	Abs Press	Sat	ecitic Val	ume Sul	Sat	(athaip	Y 5.11	¢.al	Entrag		
False 1	Sig ter	l iguid	fv.ip.	V-Apor	Liquid	14.10	Vapor	Laquet	frap Sig	Sat Vapor	1.0
187 8 187 8 184 8 186 8	7 5110 7 856 8 201 8 568 8 947	0 016510 0 016512 0 016514 0 01654 0 016559	50.71 48.177 46.12 44.383 47.521	50 22 18 187 46 249 44 400 42 638	148 00 150 01 157 01 154 02 156 01	9810 9810 9878 985 5 985 1	11 18 7 11 19 0 11 19 8 11 40 5 11 41 3	0.7531 0.7657 0.7674 0.7756	1 5490 1 5411 1 5114 1 5779 1 5713	1 #1111 1 a075 1 6010 1 8-901 1 7969	180 0
196-2 197-8 194-8 196-8 198-8	9 340 9 747 10 168 10 605 11 058	0 016572 0 015585 0 015598 0 016611 0 016624	40 94 1 39 3 17 37 808 36 348 34 954	40 957 39 154 37 874 36 364 34 970	158 01 160 05 167 05 164 04 166 08	984 1 981 6 981 6 980 4 979 1	1142 1142 9 1141 / 1144 4 1145 2	0 2787 0 2818 0 :845 0 2879 0 2910	1 5148 1 5092 1 5017 1 4952 1 4888	17914 17900 17865 17831 17728	190 0 197 0 151 0 196 0
200 0 204 0 208 0 212 0 215.8	11 3/6 17 512 11 564 14 696 15 901	0 016437 0 016431 0 016431 0 016719	33 622 21 135 28 HA2 26 782 24 878	31639 31151 78878 26799 24894	1/2 11 1/5 14 180 17 184 20	977 8 970 1 970 1 967 8	1145 0 1147 5 1147 0 1150 5	0 2040 0 1001 0 1061 0 3171 0 3181	48.24 16/1/ 45/1 4447 4373	1 7784 1 7618 1 7617 1 7588 1 7505	200 0 200 0 200 0 21 7 0 215 0
778 8 774 8 778 8 737 8	17 184 18 556 20 015 21 567 23 216	0 0167/5 0 015505 0 015814 0 015864 0 015895	21 111 21 529 20 056 18 701 17 454	21 148 21 545 20 073 18 718 17 471	188 77 197 27 194 31 200 35 204 40	964 8 954 8	1151 4 1154 2 1156 3 1157 8 1159 2	0 1741 2 1393 3 1159 0 1417 0 1476	1 4701 1 4001 1 3941 1 3842 1 3725	1 7447 1 7380 1 7170 1 7140 1 7701	270 0 221 0 220 0 232 0 236 0
748 0 746 0 746 0 752 0 754 0	24 968 26 826 28 796 30 883 33 091	0 016926 0 016958 0 016990 0 017022 0 017055	15 104 15 241 14 254 13 358 12 520	16 321 15 260 14 281 13 375 12 538	208 45 212 50 216 56 220 62 224 69	95/1 919 5 956 8 944 1 941 4	1160 6 1167 0 1161 4 1164 7	0 1513 0 1541 0 1647 0 1761	1 1499 1 3494 1 3379 1 3754	17142 17095 17528 16972 16917	240 0 248 0 748 0 752 0 756 0
64 6 64 6 77 8 76 8	35 427 37 994 40 500 41 749 46 147	0 01/0A9 0 01/12 J 0 01/15 / 0 01/15 J 9 01/12 J	11 745 11 025 10 358 4 718 9 162	11 767 11 (M2 10 175 2 755 1 180	778 76 237 83 236 31 240 59 240 59	918 6	11674 11687 11700 1171 J	0 1414 0 14/6 0 1917 0 1947	1 2041 1 2911 1 2921 1 2715	1 686.7 1 686.4 1 675.5 1 676.7	260 0 764 0 268 0 277 0 276 0
56 6 56 5 98 0 97 6 36.8	49 200 52 414 55 295 59 350 63 004	0 01/764 0 01/30 0 01/14 0 01/38 0 01/41	# 427 # 1780 7 (a. 14 7 7 301 6 #259	8 644 8 1453 7 6807 7 7475 6 8433	249 17 75 1 1 75 7 4 261 5 265 6	9717. 9717. 918.8 915.9 913.0	1171 # 1175 0 1176 2 1177 4 1178 6	0 11/14 0 41/-1 1/4 108 0 4/5 1 0 4317	1 2"-01 1 2 m5 1 2 m6 1 2 1 86 1 2 0 8 2	1 6/70 1 6/18 1 6/19 1 6/40 1 6/40	780 0 780 0 780 0 797 0 796 0
100 0 104 0 105 0 117 0 114 0	67 005 71 119 75 433 79 953 84 688	0 01/45 0 01/49 0 01/53 0 01/57 0 01/61	6 4483 6 0955 5 7655 5 4'66 5 1873	6 4658 6 11 10 5 78 10 5 4 7 6 2 5 1 8 6 9	260 7 271 8 278 0 287 1 286 3	910 0 20/0 204 0 201 0 89/7	1179 7 1180 9 1187 0 1183 1	0 41/2 0 44/5 3 44/3 0 4533 0 4586	1 19/9 1 18/7 1 1//6 1 16/6	1 4 15 1 1 4 10 1 1 4 7 0 9 1 6 16 2	101 0 101 0 108 0 117 0
176 8 174 8 126 8 132 6 136 8	89 64 1 94 876 100 745 105 907 111 820	0 01/66 0 01//0 0 01//4 0 01//9 9 01/83	4 8961 4 6418 4 4030 4 1 /88 3 9681	4 91 38 4 6595 4 4/08 4 1966 3 9859	790 4 294 6 298 7 307 9 307 1	874 8 811 6, 888 5 885 3 882	1185 7 1186 7 1187 2 1188 2 1189 1	0 4640 0 4647 0 4745 0 4798 0 4850	11477 11178 11780 11183 11086	1.5115 1.071 1.60.5 1.594 1.5936	170 0 170 0 170 0 170 0 117 0 116 0
146 6 146 8 152 8 158 8	117 992 124 610 131 143 138 138 145 624	0 01 787 0 01 792 0 01 797 0 01 801 0 01 806	3 /699 3 5834 3 40/8 3 2423 3 0863	3 7878 3 6013 3 4258 3 2603 3 1044	311 3 315 5 319 7 323 9 324 1	878 8 875 5 877 2 868 9 865 5	1190 1 1191 0 1191 1 1192 7 1193 6	0 4907 0 4954 0 5006 0 5058 0 5110	10770 10894 10799 10705 10611	1 5892 1 5819 1 5806 1 5763 1 5721	348 0 348 0 357 8 356 8
64 0 64 0 17 0 17 8	153 010 160 903 169 113 177 648 186 517	0 01 61 1 0 01 81 6 0 01 82 1 0 01 82 6 9 01 83 1	2 9392 2 8002 2 6691 2 5451 2 4279	2 9573 2 8184 2 5873 2 5633 2 4462	132 3 336 5 340 8 345 0 349 3	862 1 858 6 855 1 851 6 848 1	1194 4 1195 2 1195 9 1196 7 1197 4	05/61 05/12 05/63 05/14 05/65	1 0517 1 0474 1 0232 1 0240 1 0148	1 5678 1 5637 1 5575 1 5554 1 5513	160 0 164 0 166 0 177 0 376 0
186 0 184 9 180 9 152 0 156 8	195 729 205 294 215 220 225 516 236 193	0 01836 0 01842 0 01847 0 01853 0 01858	2 31 70 2 21 20 2 11 26 2 01 84 1 92 91	2 3353 2 2304 2 1311 2 0369 1 9077	353 6 357 9 362 2 366 5 370 8	844 5 840 8 817 7 833 4 879 7	1178 0 1198 / 1199 3 1179 9 1200 4	0 5415 0 5466 0 5516 0 5547 0 3617	1 0057 0 9966 0 9876 0 9786 0 9696	1 5473 1 5412 1 5172 1 5152 1 5113	186 8 154 8 188 8 197 8 196 9
100 0 104 0 104 0 117 0	267 759 258 725 270 6600 287 854 295 617	0 01864 0 01870 0 01875 0 01881 0 01887	1 5444 1 7540 1 6877 1 6152 1 5462	1 96-30 1 78-27 1 706-6 1 6 3-40 1 5-6-5 i	375 1 379 4 383 8 398 1 392 5	8/5 9 8/2 0 41 8 2 81 4 7 81 0 2	1201 0 1201 5 1201 9 1202 4 1202 8	0 166/ 0 5/1/ 0 5/16 0 1816 0 1866	0 9607 0 9518 0 9429 0 9 151 0 9 2 5 3	1 5274 1 5214 1 5195 1 5157	400 0 401 0 406 0 417 0 415 0
170 6 120 0 120 0 120 0 120 0	308 /80 327 /91 336 453 351 00 366 03	0 01894 0 01900 0 01906 0 01913 0 01919	1 4808 1 4184 1 3591 1 30266 1 24887	1 4997 1 4374 1 3782 1 32179 1 26806	396.9 401.3 405.7 410.1 414.6	806 Z 802 7 738 0 793 9 789 7	1703 1 1703 5 1703 7 1704 0 1704 2	0 5915 - 0 5964 0 6914 0 6063 0 6112	0 21A5 0 2077 0 8990 0 8903 0 8816	1 1004 1 1004 1 1466 1 4928	478 8 474 8 478 8 478 8 432 8
140 0 144 0 152 0 152 0	381 54 397 56 414 09 431 14 448 73	0 01976 0 01933 0 01940 0 01947 0 01954	1 19/61 1 148/4 1 10212 1 05/64 1 01518	1 21687 1 16806 1 12152 1 07711 1 03472	4190 4235 4780 4125 4370	785 4 781 1 776 7 777 1 767 8	1204 4 1204 6 1704 7 1704 8 1204 8	0 6161 0 6210 0 6259 0 6 108	0 8/29 0 8613 0 8557 0 8471	#890 #85 1815 4778	440 0 444 0 448 0 457 0

femp	Atts Prints	5.0	Specific Vi	aturated Summe	ς,	- 6	gis, Atn	,			fate		
fate 1		(opin	d frap	V.igini	1 - p	nt	frage Note	Victoria N p		Logar			i i e
464 6 464 6 468 6 477 8 476 6	475.87 485.56 504.81 574.67 545.11	001% 001% 001% 001%	0 0 7/467 0 0 7/7.88 0 0 8/1885 4 0 86345	0.95474 0.7577 0.71847 0.88379 0.84950	43) 4 44. (4'.) (4',) (7617 /\46 /\491 '445	1704 8 1764 7 1,154 6 1704 5 1204 3	0	64174 6174 6174 6179	1. 4. 59 1. 4.11 1. 1.1 0. 1.1 0. 1.1 0. 1.2 0. 1.2 0. 1.2 0. 1.2		464 0 464 0 464 0 477 0 475 0
454 0 454 0 454 0 497 0 496 0	5A/ #1 610 10 611 01 656 61	0 0.70 P 0 0.70 P 0 0.70 P 0 0.20 P	0 /6413	0 81717 0 78677 0 79678 0 77870 0 70100	4: 4 5 4: 1 7 4/18 478 5 483 2		7174 714 7 774 6 7195	1,04 (12018 12015 1203 (1202 7	0	64 14 6-15 6-15 6-417	0 '871 0 ':45 0 ':50 0 //:14 0 /528	1 15 14 1 15 -: 1 1222 1 1407 1 4173	400 0 404 0 404 0 407 0 407 0
300 0 304 0 306 0 317 0 316 0	6,80 86 705 78 731 40 757 77 784 76	0 0.704 0 0.705 0 0.705 0 0.707 0 0.708	0 60530 0 60530 0 58718	0.57492 0.64991 0.67592 0.60789 0.8079	487 9 497 7 497 5 507 1 507 1		7143 7090 7017 4487	1207 2 1201 7 1701 1 1700 5 1127 8	0	6810 6919 6187 1016 7085	07441 97357 97371 97345 97349	4111 4111 4116 4711 41,41	500 0 104 0 500 0 517 0 516 0
570 0 574 0 578 0 532 0 536 0	#17 53 #41 04 #70 31 900 34 931 17	0 0 2102 0 02102 0 02123 0 02123	051814	05546 05716 051955 050070 048257	517.0 516.2 521.8 524.8 531.7		470 411 6755 695	1154.7 1154.7 1195.4 1195.4	200	71 13 71 82 77 31 77 80 7329	0 7011 0 - 14 0 - 152 0 - 152 0 - 153	(4) 1A (4) 78 (4) 73 (4) 73 (4) 73 (1) 20 91	520 0 520 0 520 0 527 0 538 0
548 8 548 8 548 8 552 8 536 6	967 79 994 27 1078 49 1062 59 1097 55	0 02145 0 02157 0 02154 0 02158 0 02194	042677	0 44814 0 41217 0 41560 0 40160	514 8 514 9 54: 0 557 2	6 6	575 513 450 185	11943 11911 11919 11906 11892	0	7778 7277 7474 7575 7575	059// 07:43 06:70 05:10 04:22	1 1054 115-1 115-1 115-1 115-1 115-1	540 0 544 0 518 0 552 0 556 0
560 6 564 8 568 0 577 0 576 4	1133 38 1170 10 1207 72 1246 26 1285 74	0 02207 0 0221 0 02215 0 02249 0 02264	0 36507 0 35099 0 33741 0 32429 0 31162	0 38/14 0 1/320 0 359/5 0 346/8 0 33425	567.4 567.4 577.7 578.3 583.7	6	75 3 18 5 11 5 04 5 37 2	11877 1185 1 1181 5 1182 7	0	74.75 74.74 77.75 77.75	0 %: 12 0 %: 12 0 %: 50 0 %: 50 0 %: 56	1374	160 0 564 0 568 0 577 8 576 8
584 0 584 0 588 0 582 0 586.8	1376 17 1367 7 1410 0 1453 3 1497 8	0 02279 0 02795 0 02111 0 07128 0 02345	0 29937 0 28753 0 27668 0 26499 0 25425	0 37216 0 31048 0 27719 0 28827 0 27770	589 5916 500 505 / 611 4	5	A7 9 A7 4 74 7 56 8 58 8	1179 0 1176 9 1174 8 1177 6 1170 2	0	78/6 19/1 19/1 19/1 10/10 10/82	0 5473 0 5480 0 5380 0 5390 0 5793	1 3507 1 3464 1 3470 1 3375	580 8 584 8 588 8 597 8 598 8
608 8 604 8 608 8 617 8 616 6	154 1 2 1589 7 1617 3 1686 1 1735 9	0 02402 02 0 02402 02 0 02402 02	74484 0 26 13174 0 25 12134 0 24 1142 0 23 10516 0 22	757 796 865	677 W 678 R 614 R	5576 5477 5116 5747 5156	1167 1165 1167 1150	1	0 #134 0 #187 0 8740 0 8734 0 8348	051	97 1 12 97 1 21 96 1 11	19	607 0 604 0 608 0 617 0 616 0
678 6 674 6 674 6 678 6 678 6 678 6	1786 9 1813 0 1813 4 1947 0 2007 8	002514 01 002514 01 002539 01	96.15 0.72 A/1/ 0.71 /XAB 0.71 /D44 0.17 67.76 0.18	276 194 583	646 9 6511 653 5 565 9	516 T 616 A ENG 7 876 B	1149 1149 1146 1147 1138	1 7	0 #103 0 #118 0 #118 0 #571 0 #678	0 414	49 100 41 100 44 179	07	679 0 671 0 678 8 617 8 628 8
48 8 46 8 48 8 57 8 54 8	20%9 9 211 # 3 217# 1 2239 2 2301 7	0 02675 0 1 0 02657 0 1 0 02691 0 1	5477 018 4644 017 1876 016 3124 015 2387 015	269 534 816	585 y 602 9 700 0	444 6 443 1 431 1 418 7 405 7	1113 1129 1124 1118 1113	7	0 85.45 0 8745 0 8868 0 8931	0 41 0 40 0 374 0 36	14 1 74 15 1 27 15 1 26 17 1 26	21 61 79	640 E 644 E 657 E 658 E
66 6 64 6 72 6 72 6	2365 7 2431 1 2466 6 2636 8	0 0 2 8 5 8 0 1 0 0 2 8 5 8 0 1 0 0 2 9 1 1 0 0	1643 014 0947 013 0229 013 9514 012 8/99 011	757 087 126	722 9 711 5 740 2	347 1 377 7 347 1 345 7 378 5	1107 (1100 (109) 1085 (1077 (0 8995 0 9054 0 9137 0 9212 0 9287	0 350 0 334 0 121 0 305 0 289	02 1 74 11 1 74 10 1 21 14 1 27	98	668 6 664 6 666 8 672 8
## 0 ## 0 ## 0 ## 0	2708 6 2782 1 2857 4 2934 5 3013 4	003114 00 003204 00 003313 00	8080 0 11 7349 0 10 6595 0 09 5797 0 09 4916 0 08	16 } 79 9	768 2 778 8 790 5	1101	1068 1 1058 4 1047 (1033 8 1017 2		0 9365 0 9447 0 9535 0 9634 0 9749	0 272 0 253 0 233 0 211 0 184	0 1 201 17 1 13 17 1 18 0 1 17	86 14 77	680 0 684 0 688 0 697 0 696 0
50 6 97 6 54 6 95 6 85 47*	3094 3 3135 5 3177 7 3178 3 3204 2	001874 00: 004108 00: 004427 00:	3857 0 079 3173 0 064 7197 0 06 1304 0 054	519 997 100 730	877 4 815 0	72 7 44 7 07 0 61 4	995 2 979 2 956 2 914 4 906 0		0 9901 1 0006 1 0169 1 0179 1 0612	0 149 0 124 0 087 0 057 0 000	0 1139 6 1179 6 1104	90 12 16	700 0 707 0 704 0 705 0

*Critical temperature

Table 2: Saturated Steam: Pressure Table

Abs Press	lemp	Sat Spe	ecific Value	ne	areled Sit	Fatnalpy			Entropy		
Lb/Sq In.	fahr	Liquid	fung Vig	Sat Vapor Va	Liquid hi	Evap N ₁₄	Vapor h g	Liquid	Evap	Vapor Vapor	And Pres
6 54663 6 75 6 36 1 6 5 6 16 8 14 654 15 8	37.018 59.371 79.586 101.74 162.74 173.71 217.00 213.03	0 014027 0 014027 0 014071 0 014407 0 014407 0 014507 0 016507	1402 4 1215 5 641 5 131 50 73 515 18 404 26 782 26 274	3 (02 4 12 (5 5 641 5 311 (4) 73 5 (2) 38 420 28 799 28 290	0 nnn 3 27 i A2 47 · 1 47 · 1 1 i n 20 1 A1 · 6 1 Mt 1 / 1	1075 5 1060 1 1013 6 10 6 1 1030 9 987 1 970 3	10/5 5 1087 4 10 6 1 11 10 8 11 11 1 11 10 5 11 10 9	0 mmm 0 mmm	2 1877 2 04 11 1 1837 1 1837 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	71877 20.45 10.41 1.41 1.41 1.41 1.74 1.76 1.76 1.76 1.76 1.76	3 200 3 27 0 70 1 0 10 0 10 0 10 0 10 0 10 0 10 0
70 0 70 0 40 0 50 0 60 0 70 0 80 0	277 96 250 34 267 25 281 07 292 71 302 93 317 04 320 28	0 01 58 14 0 01 70 M 0 01 715 1 0 01 7274 0 01 7383 0 01 7482 0 01 7573 0 01 7659	20 070 13 7766 10 4794 8 4967 7 1567 6 1875 5 4536 4 8779	29 087 13 /436 10 4965 8 5140 7 1716 6 2050 5 4/11 4 8953	196 27 218 9 218 1 250 2 262 7 277 7 782 1 290 7	94 2 94 2 9116 9114 9154 917 8 910 9	11/6 1 11/6 8 11/6 8 11/7 6 11/7 6 11/7 6 11/7 6 11/7 1 11/7 6	0 3358 0 3682 0 3571 0 3512 0 4273 0 4411 0 4534 0 4643	1 3047 1 3313 1 2844 1 2474 1 2167 1 1205 1 1675 1 1470	1 / 1 / 0 1 / 2 / 0 1 /	29 6 30 0 40 0 50 0 60 0 70 0 80 0
186 8 118 7 128 8 138 8 146 8 156 6 166 8 170 8	327 82 334 79 341 27 347 33 351 04 358 43 361 55 368 42 377 53	0 017740 0 01782 0 01783 0 01803 0 01803 0 01815 0 01821 0 01827 0 01833	4 4(13) 4 0106 3 7097 3 4164 3 7010 7 9958 7 8155 2 6556 2 5129 2 3847	4 6110 4 0124 3 7275 3 4544 3 2170 3 0139 2 8336 2 5738 2 5312 2 4030	7:85 31:58 31:50 1:50 1:50 1:50 1:50 1:50 1:50 1:50	883 6 881: 477 8 877 8 877 8 863 4 852 0 853 7 846 7	118/2 11589 11594 11917 11917 11941 11951 11960 11949	0 37:11 0 14:13 0 19:13 0 17:13 0 17:11 0 17:14 0 5:74 0 5:74	1 1.744 1 1115 1 7.65 1 78:5 1 78:5 1 78:1 1 75:54 1 74:5 1 77:5 1 77:5 1 71:1	1 (4777 1 (4747) 1 (4777) 1 (4777) 1 (4777) 1 (4777) 1 (4777) 1 (4777) 1 (4777) 1 (4777)	100 8 110 0 179 9 130 8 146 8 156 8 176 0
200 0 210 0 210 0 230 0 240 0 250 0 260 0 270 0 270 0	JR1 80 IR2 91 IR9 88 J91 70 J97 J9 J00 97 404 44 407 80 411 07 414 25	0 01819 0 01859 0 01855 0 01860 0 01875 0 01876 0 01875 0 01880 0 01885	2 2689 2 16173 2 16173 2 16779 1 37991 1 89909 1 87452 1 75548 1 69137 1 63169 1 57597	7 1871 7 18717 7 18717 7 18767 1 9 1846 1 1769 1 184317 1 77418 1 71013 1 65049 1 59482	152 7 152 7 164 7 164 7 167 1 177 9 181 6 187 1 190 6	#17 4 #15 4 #16 4 #28 4 #28 4 #28 5 #16 5 #18 3 #15 1	1108 1 1179 0 1177 6 1270 1 1207 6 1201 1 1201 5 1201 6	0 5118 0 5540 0 5540 0 5614 0 5677 0 5664 0 5605	1 1911 A 0 1973] 9 16 14 0 174 A 0 174 A 0 174 A 0 174 A 0 174 A	1 5154 1 5174 1 5174 1 5175 1 5164 1 5176 1 5176 1 5176 1 5176 1 5176	200 4 210 0 210 0 240 0 250 0 260 0 270 0
200 0 350 0 000.0	417 35 431 73 444 60	001889 001912 001934	1 57384 1 30642 1 14162	1 54274 1 32554 1 16095	394 0 409 8 424 2	808 9 794 2 780 4	1202 9 1204 0 1204 6	0 5882- 0 6059 0 6217	0 9773 0 8909 0 8630	15105	300 0 350 0 400 0
450 8 500 0 550 0 600 0 650 0	456 28 467 01 476 94 486 20 494 89 503 08	0 01254 0 01975 0 0176 0 07013 0 02050	0 %71% 0 %71% 0 74% 0 64%	0 97/67 0 841/7 0 76975 0 70843	41/3 44°5 4/4°5 4/1 / 481 9 491 6	767 5 755 1 711 3 717 0 77 0 9 71 0 7	1704 # 1704 / 1704 J 1701 / 1707 8 1701 4	0.51cm 0.520 0.521 0.521 0.641 0.647	0 A148 0 7946 0 7248 0 7557	1 17 4 1 26 4 1 27 17 1 4261 1 4 541 1 4 104	150 500 512 502 630 700
758 0 900 0 856 0 950 0 950 0 1500 0 1556 0 1700 0 1756 0	510 84 518 71 575 74 511 75 518 10 544 58 550 51 556 28 561 82 567 19	0 07049 0 07103 0 07171 0 07171 0 07177 0 07177 0 07214 0 07214	0 54M2* 0 5110/ 0 47/ma 0 65/ma 0 174 6 0 4/9047 0 37861 0 35/659	0 568/6 0 5 1 102 0 50901 0 47705 0 44746 0 47774 0 41958 0 18073	500 9 517 8 518 4 526 7 518 7 543 6 557 5 564 8 571 9	670 8 670 5 6617 660 1 600 1 610 3 611 3 611 3	1200 7 1177 8 1178 0 1176 4 1176 4 1171 0 1189 1 1187 0 1184 8	0 /072 0 /111 0 /157 0 /157 0 /157 0 /157 0 /157 0 /157	0.7210	1 1 17 1 4 15 1 1 10 4 1 10 1 1 10 1 1 10 1 1 17 1 1 17 1 1 16 1	758 433 453 100 400 1860 17,3 1100 1758 1760
1256 8 1308 6 1356 6 1406 5 1456 6 1556 8 1656 8 1656 0 1706 6	572 38 577 42 582 32 587 07 591 70 596 20 600 59 604 87 609 05 613 13	0 07750 0 07769 0 07788 0 02307 0 02337 0 02366 0 02367 0 02407 0 02408	0 30772 0 29250 0 27871 0 26546 0 25372 0 24235 0 23159 0 22143	0 32991 0 31537 0 30178 0 78911	5788 5856 5973 5988 6053 5417 6187 6304 6365	5018 5346 5456 5474 5474 5484 5401 5411 5277	11826 11802 11778 11778 11771 11778 11701 11674 11645 11586	0 7780 0 7843 0 7906 0 7956 0 8075 0 8142 0 8199 0 8754 0 8109	0 5850 0 5733 0 5670 0 5507 0 5787 0 5787 0 5076 0 4971	1 1519 1 1527 1 15 15 1 1573 1 1573 1 1573 1 1574 1 1775 1 1775	1250 1300 1350 1450 1450 1500 1500 1500 1500 1500 15
1758 0 1890 0 1858 0 1990 0 1958 8 2006 0 2198 8 2208 0 2308 8	617 12 621 02 624 81 628 56 632 22 635 80 642 76 649 45 655 89 662 11	0 02450 0 02472 0 02473 0 02517 0 02541 0 02565 0 02727 0 02727	0 20253 0 17190 0 18558 0 17761 0 16796 0 16786 0 14885 0 13803 0 1787	0 22713 0 21861 0 21052 0 20278 0 19540 0 18831 0 17511 0 16272 0 15133 0 14076	647 5 618 5 654 5 666 3 677 1 68 7 707 7 719 0	413 1 403 8 485 2 475 8 486 2 1.16 7 4.16 7 4.16 7 4.16 8	1155 6 1157 3 1149 0 1145 b 1147 0 1118 3 1110 5 1111 2 1111 2	0 \$163 0 \$417 0 \$470 0 \$572 0 \$572 0 \$675 0 \$777 0 \$4 8	0 4755 0 4657 0 4359 0 4359 0 4756 0 1051 0 1810	13178 13079	1756 8 1800 0 1852 0 1950 0 1950 0 2100 0 2100 0 2100 0 2100 0
7586 6 2686 0 2768 0 2768 0 2966 0 2966 0 3108 0 3108 0 3206 0 3206 0	668 11 673 91 879 53 684 96 690 72 695 33 700 28 705 08 705 47	0 02859 0 02938 0 03029 0 03134 0 03262 0 03478 0 03681 0 04172 0 05078	0 10709 0 09177 0 08165 0 07171 0 06158 0 05073 0 03771 0 01131	0 13068 0 12110 0 11194 0 10305 0 09420 0 08500 0 07452 0 05663 0 05078	711 7 744 5 74.7 3 77.7 7 785 1 801 8 874 0 875 5 906 0	Mil 6 1176 3121 2851 2547 2184 1693 561	1001) 1082 0 1094 7 1055 8 1039 8 1070 3 293 3 293 3 906 0	0 71 19 0 7127 0 7176 0 9358 0 9738 0 9714 1 7151 1 0612	0 1/06 0 27/7 0 2/41 0 2/491 0 2015 0 1891 0 1/450 0 0/47 0 0000	1 7115 1 7715 1 7458 1 7873 1 1519 1 1373 1 108.22 1 06.12	2400 0 2500 0 2500 0 2500 0 2500 0 3000 0 3100 0 3100 0 3200 0

*Critical pressure

6.0 Plant System Design, Control and Instrumentation (25.0)

6.1	With regard to the <u>Vessel Instrumentation</u> :	
	a. For what specific condition(s) is the Fuel Zone Range level indicators calibrated?	a (1.0)
	b. For the Narrow Range Level Indicators, MS-LIS-24A,B,C &	D: (2.0)
	 Where are they located in the plant? To what systems/components do they send signals? At what levels are these signals initiated? What system/component action is initiated? 	
	c. How is the signal for <u>jet pump flow</u> generated in an <u>individual</u> (non-calibrated) jet pump?	(1.0)
	1 212° Fat Opegon 7 (05%)	
6.1	a. (Saturated steam conditions) at 0 psig in the vessel and drywellawith no jet pump flow (055)	(1.0)
	b. 1) Located in Reactor Building, 522' level.	(0.5)
	RCIC/RCIC turbine; at level 8; shut steam supply, RPS; level 3; scram and NSSSS Group 5 and 6 isolation C. Pressure, at pressure tap on pump throat, ais compared to a common jet pump discharge pressure sensed at the core inlet plenum area by the SLCS injection line to develop a AP signal assure as	(0.75) Ons. (0.75) Oth but require Att water TIP without (1.0)
	Ref: WNP-2, Systems and Procedures: NBI, pgs. 5, 14 and 9, respectively.	
·w	here extra way as men your , doubt water appropriate was (1.2. KPS+PC	10714 - Some veleglans.

6.2 With regard to Process Radiation Monitoring:

isolation or trips?

a. The main stream line radiation monitoring system will initiate condenser isolation (via AR-V-1) when appropriate channels and their trips are activated. What are these channels and trips?

(1.0)

b. What type of detector (G-M, etc.) is used in the following radiation monitors:

(1.5)

1) Rx Building stack extended range
2) Off-gas post treatment
3) Circulating water effluent?

c. Which of the monitors, in b. above, will initiate system

(1.0)

6.3 With regard to the Emergency Diesel Generators:

- a. What are all the start signals for DG #2? (1.5)
- Describe the <u>overspeed trip</u> mechanism (including its location, its major components, and how it initiates an engine trip).
- c. What is the purpose of the soak back pump? (0.75)

6.3 a. 1) Bus SM-3 dead (0.3) or TR-S undervoltage (0.3)

3) SM-8 undervoltage (0.3)

4) (K988) Econtainment high pressure or reactor low water level (2.1) Level 1 (0.3)

b. Located in the camshaft counterweight housing (0.5).; it consists of a flyweight held by a tension spring. When engine exceeds set limit, spring tension is overcome by centrifugal force acting on the flyweight, permitting an outward movement of the flyweight which actuates the trip lever (0.3)

This causes latching the injector rocker arm in the depressed position, preventing fuel injection into the engine (0.5). (2.0)

C. To provide oil to the turbocharger for prelubrication. (0.75)

Ref: WNP-2, Systems and Procedures: DG, pg. 62; Fig. 14; and Fig 8c and pg. 22, respectively.

dued James Intonie.

Total danse used to tril lever

- 6.4 With respect to the Automatic Depressurization System (ADS):
 - a. What ADS controls are located on control room backpanels
 P628 and 631, and which components do they control? (1.0)
 - b. Under what normal condition(s) will pushing the four ADS main initiation pushbuttons not result in ADS initiation?
 What is the reason for this? (1.5)

- 6.4 a. (14) AUTO/OPEN control switches; SRVs "A" and "B" regular (1.0)
 - b. If a low pressure ECCS pump is not operating (0.75); so that core will not be uncovered (0.75) (1.5)

Ref: WNP-2 System and Procedures, ADS, pg. 13 and 8, respectively.

(b) cose of company.

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That we inclid.

6.5	With regard to the AC Electrical Distribution System:	
	a. Which lockout relay will be tripped upon a Transformer Differential Current (87TM)?	(0.5)
	b. List three (3) actions which will occur when the lockout relay in (a) is tripped?	(1.5)
	c. The loss of which 480V MC bus will deactivate both loops of shutdown cooling? (9 - **Simulation min to provide the state of the s	(0.5)
	d. What happens upon the loss of the normal and startup A sources for SM-4?	(0.75)
	daring again.	
6.5	a. Unit lockout (86XU)	(0.5)
	b. [any 3, 0.5 pts each]	(1.5)
	Trips and locks-out all "N" breakers Trips (AF circuit breaker) (Generator Exciter Field Breaker) Trips main turbine (20 AST) De-energizes 86XIU Starts oscillograph Starts computer C. MC-8-B-A (we destint when all and free the computer) d. Automatic transfer of SM-4 to the Division 3 EDG Referry 15M-4 by 0w3 ppc 15m to winter 200 on	
	C. MC-8-B-A (was deatersty RMR. U.9).	(0.5)
	d. Automatic transfer of SM-4 to the Division 3 EDG	(0.75)
	Ref: WNP-2 System and Procedures; AC Distr.; pg. 15 and 16 for a, b, d; AOP 4.7.1.9, Loss of Power to SM-8, pg. 3 of 4 for c.	
	close all 5' bules to be bearing the same of the backer of the backer of the backer of the same of the	
- (Abel W. hish hip amount	

6.6 For the Reactor Core Isolation Cooling System, what position should the RCIC-V-8 and RCIC-V-63 keylocked control switches be placed in prior to resetting any isolation signal? Why? (1.5)

veset

6.6 CLOSED or STOP (0.5); otherwise (i.e. in OPEN), when isolation signal is received the valves would immediately open (0.5) which could cause extensive damage to system piping and components (0.5).

(1.5)

Ref: WNP-2, SOP 2.4.6, pg. 2 of 28.

- 6.7 If a selected control rod is in the selected 4 rod group and too many reed switch closures occur:
 - a. What indication(s) would the operator observe? (1.0)
 - b. How could the control rod be moved through this position? (0.75)

(9 - RSCS MRLUM AND group

(A- annu for both of moth hay tracelle.)

(forthe 1 pay # 2 on at.)

- Stop he late wie unpertopture the terminden (4 rol group

6.7 a. RPIS Data Fault, Insert Block would light. withher black. (1.0)

b. By using Substitute Data on RSCS(0.375) on hypaning on 1850 (0.175) (0.75)

Ref: WNP-2 Systems and Procedures, RMCS, pp. 15, 16.

if additional way answers to by # of answers to get value per answer.

6.8 What design provisions are made to assure air flow through Standby Gas Treatment System filters. What is the basis for this?

(1.75)

6.8 Each SGT train has two full-capacity fans powered from separate emergency buses (0.75); to prevent filters from igniting on loss of air flow due to the decay heat generated by entrained radioactive materials (1.0100)

2) heaters on what (1.75)

Ref: WNP-2 Systems and Procedures, SGT pg. 24,3, filts blokase (0.01)

(0.320)

(0.320)

(0.320)

(0.320)

(0.320)

(0.320)

(1: 25 . 15 W 3]

18

6.9 With regard to the Average Power Range Monitor System (APRM):

a.	What three (3) things could happen if the back panel APRM Mode Switch was placed into the standby position during	
	normal operation?	(1.0)
b.	What is the AC power source for APRM Channel F?	(0.5)
c.	Why is the Thermal Power Monitor necessary?	(1.0)

6.9 a. APRM operates normally if bypassed (0.33); gives an INOP trip (to warn operator if channel has not been bypassed) (0.33). Will give 1/2 scram(if channel not bypassed) (0.33).

b. (Bus B supplied by) RPS MG set B. (1.0)

c. To avoid unnecessary scrams during power increase transients (due to flux leading thermal power). (1.0)

Ref: WNP-2 Systems and Procedures, APRM, pp. 26, 28 and 32-33, respectively.

egel your hunde 1.0 by 4 = . 25

7.0 Procedures - Normal, Abnormal, Emergency, and Radiological Control (25.0)

7.1 According to procedures for Emergency RPV Depressurization (Contingency) (5.3.2):

a. What is the primary system used to cause depressurization? (0.5)

b. If the system in (a) is partially or totally unavailable, what is the next system to be used? (0.75)

c. Under what conditions would systems other than those in
a) and b) above be used and what are these systems? (2.5)

7.1 a. ADS (0.5)

b. Other SRV's until 7 are open (.25) (0.75)

c. If <3 SRV's are open (0.5); main condenser, main
steam line drains, RCIC, head vents (2.0) (2.5)</pre>

Ref: WNP-2 EOP 5.3.2, pp. 1, 1, and 2 of 8, respectively.

7.2 What changes to the reactor power, MCPR, and MAPLHGR operating limits are required before one (1) recirculation loop operation is permitted? (2.25)

7.2 (0.75 each) NONE.

(2.25)

Reactor power: reduce it to <50% rated thermal power

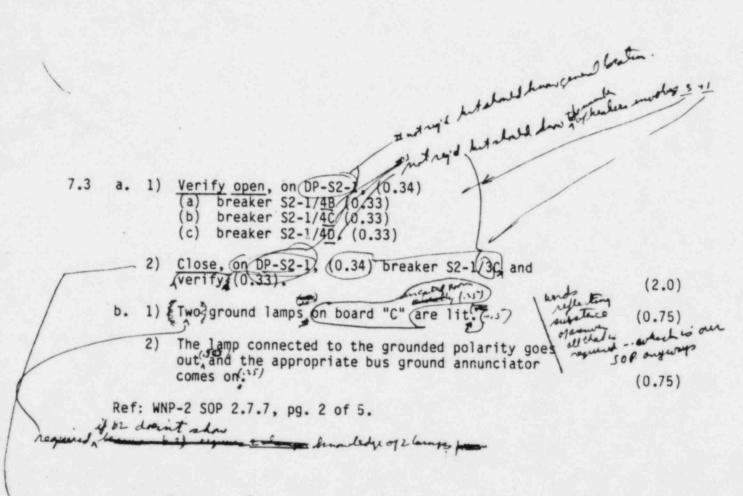
MCPR: increase it by 0.01

MAPLHGR: reduce limit to 0.84 times the two loop op. limit.

Ref: WNP-2 AOP 4.2.1.10, pg. 2 of 3, and T.S. 3.4.1.1, pg. 3/4 4-1.

7.3 With regard to the operating procedure for 250V DC Distribution System (SOP 2.7.7):

- a. What should the operator do and where would he do it, to tie the 250V DC battery B2-1 to the 250V DC distribution bus S2-1? (2.0)
- b. When bus S2-1 is energized:
 - 1) What indication(s) does the operator have that no ground is present? (0.75)
 - 2) What indication(s) does the operator have when a ground develops? (0.75)



>2) Close heater 52-1/30 (0.34) on 0 p-32-1 and weeky (0.33)

Acostin Con Apricability of Acost of Rispuse Sterry ster with Ragio. 7.4 According to WNP-2 Annunciator Procedures, if the "OFF GAS VAULT RAD MONITOR DNSCL" annunciator alarmed, the operator should make a "verification" and a "check". Describe the verification and check to be made and at what location in the plant.

(2.0)

7.4 Verify: downscale condition of OG-RIS-11 (0.5); at P606 (0.5) (1.0)

Check: radiation level of QG-RI-11 (0.5); locally (0.5) (1.0)

Ref: WNP-2 Annunciator Procedures, 4.602.A5-4.2.

Ster by step et Memorized Response Not megid.

- 7.5 According to the Operating Instructions for the Control Rod Drive System (SOP 2.1.1):
 - During system startup, what should be the position (open or closed) for the following Hydraulic Control Unit (HCU) valves:

(2.0)

- 1) CRD-V-111 (Cartridge Valve Nitrogen Inlet)
- 2) CRD-V-107 (Accumulator Water Drain)
- 3) CRD-V-102 (Withdraw Water Isolation)
- 4) Withdraw Line "Dragon" valve.

b. Buring system startup, in what position should the operator place the charging water header vent valve (CRD-V-65) that is located between the charging water header isolation valve (CRD-V-34) and the HCU charging water inlet isolation valves (CRD-V-113/HCU)? Why?

(1.6)

- (2.0)p) after supeter fully we (and any sec or and changed)
 - Open
 - 2) Closed
 - 3) Open
 - 4) Closed

Open (0.5); to provide leak off (0.5) so that HCU accumulators will not pressurize due to valve leakage (0.5)

Ref: WNP-2 SOP 2.1.1, pp. 4 and 6 of 41, respectively.

- According to the procedures for Normal Shutdown To Cold Shutdown (G.O.P. 3.2.1), at what percent power (approximate) 7.6 should the following actions be performed? (2.0)
 - Transfer the 6900 volt switchgear from the normal auxiliary transformer to the startup transformer.
 - Remove one feedwater pump, one condensate booster pump and one condensate pump from service.
 - Verify operability of RWM and RSCS.
 - Transfer recirculation pump to 15 Hz.
 - e. Unload and shut down main turbine.

- 7.6 (0.4 ea.) (2.0)
 - <20% >15% b. <40% >35% 420% >15% (Nobstree" Below LPSP "lete ellume las after 35% reducing power to 20 ? of capit?
 - d. <5% e.

Ref: WNP-2 GOP 3.2.1, pp. 4, 3, 4, 3 and 11, respectively.

7.7	According to	the	procedure	AOP	4.7.4.1	for	Loss	of
	Inverter-1(IN-							

a. What are two (2) of the three annunciator alarms the operator should see? (1.0)

b. What two (2) automatic actions will occur? (1.0)

c. If voltage is not normal on US-PP, list the actions that should be taken and in their preferred sequence. (1.5)

7.7 a. Annunciator alarm (any 2, 0.5 ea.): (1.0)

1) "250 VDC Inverter ALT Source Loss"

2) "250 VDC Inverter ON ALt Source" Loss"
3) "250 VDC Inverter TROUBLE Alt source Loss"

b. (0.5 ea.) (1.0)

1) Static switch transfers to ALT AC input (MC-7F) 2) DEH system will auto transfer to alternate AC.

(Martin wing amules give, durade 1.0 by dofamines to c. (0.4 ea. action; 0.1 ea. sequence) (1.5)

1) Attempt to restore IN-1 to service, or (the same 2) Switch IN-1 to "Maintenance" position, or

3) Shift US-PP to bypass source via "KIRK KEY INTERLOCK" (MC-7A).

Ref: WNP-2 AOP 4.7.4.1, pp. 1, 1-2, and 2, respectively.

- 7.8 With regard to Accident Monitoring Instrumentation, according to Tech. Specs.:
 - a. Under what operational conditions (use number only) are the following instruments to be operable? (2.0)
 - Post-accident Sampling Primary Coolant radiation monitor
 - 2) Standby Service Water Flow
 - 3) Neutron Flux IRM
 - 4) Safety/Relief Valve Position Indicators.
 - b. For the instruments in (a) above, what are the required minimum number of operable channels? (1.0)

7.8 a. 1) 1, 2, 3 (0.68)

2) 1, 2 (0.44)

3) 1, 2 (0.44)

4) 1, 2 (0.44)

(2.0)

b. (0.25 ea.)

(1.0)

1) 1

2) 1/160p

3) 1

4) 1/valve

Ref: WNP-2, Tech. specs., pp. 3/4 3-71 and 72, 71 and 72, respectively.

Dolelezione.

7.9 According to the WNP-2 Health Physics Program:

- a. For Emergency Exposure Guides, two (2) emergency situations are given with their exposure guideline values. What are these situations and values? (1.0)
- b. An RWP is required when work is to be performed in an area that is posted for airborne radioactivity 5% of MPC (TRUE or FALSE). (0.5)

- 7.9 a. [situation (0.35), value (0.15) ea.] (1.0)
 - 1. Life saving 75 rems whole body(.05)
 2. Protection of public health or property 25 rems (.10)
 whole body (.05)
 - b. False (0.5)

Ref: WNP-2, Health Physics Program; 3.1.5 pg.3 and 3.1.8 and pg.2, respectively.

- 8.0 Administrative Procedures, Conditions, and Limitations (25.0)
- 8.1 a. What are the $\frac{\text{two}}{\text{unidentified}}$ (2) LCOs with regard to leakages from (1.25)
 - b. What is the basis behind the unidentified leakage rates? (0.75)

- 8.1 a. 1. 5 gpm total (0.5) 2. 2 gpm increase within any 4-hr period. (0.75)
 - b. The crack associated with such leakage would not grow rapidly (would be less than the critical size for rapid propagation). (0.75)

Ref: WNP-2 Tech. Spec., pg. 3/4 4-9 and B 3/4 4-2, respectively.

8.2 During plant shutdown, the maintenance supervisor informs you that on routine checking he und the Division 1 250 volt battery B2-1 discharged, the reason unknown: Do Tech. Specs. required action (YES or NO)? Explain. (1.5)What three battery "parameters" are checked at least once every seven days to verify they meet Category A surveillance requirements? PKS) Tes, (0.5); with less than Div. 1 and/or Div. 2 above required battery or chargers operable, suspend core alterations, handling of irradiated fuel in sec. containment and operations with potential of draining vessel (1.0) (1.5)b. (0.5) each: Electrolyte level Float voltage Specific gravity

Ref: WNP-2 T/S, pg. 3/4 8-15 and 8-14 respective

(a) - Correct answer for condition 4 or superstand

NO: (0.35) (assuming but 2 operable) poly neg Devi or Bev 2 (1.0)

Yes (0.35) (assuming but 2 inspection), the susperd one alterates

(-5) (-5) (-5) (-5); restar important to operable alternation)

(-6) (1.0)

The forester and condition 3 (0.5); restar important to operable alternation and the condition 3 (0.5); restar in position to operable alternation and the condition 3 (0.5); restar in position and the condition of the condition and the condition of the

- Which of the following occurrences require 1 hour reports 8.3 to the NRC: (2.0)
 - a. reactor water level -50 inches
 - b. reactor water level < -129 inches
 - c. site boundary dose > 50 MR/hr whole body
 - d. stuck open main steam relief valve

() introqued frewdil

8.3 All of the 4 occurrences (since each requires a declaration of an emergency event and this is a category of reportable events). Ref: CAF.

(2.0)

8.4 With regard to the Fire Brigade:

a.	What is the minimum number of personnel required?	(0.5)
b.	Who are specifically excluded from the Fire Brigade?	(0.75)
с.	Where and when is the Fire Brigade to be maintained?	(0.75)

b. The Shift Supervisor the STA and the 3 members of the minimum shift crew necessary for safe shutdown of the unit and any personnel required for other essential functions during a fire emergency.

(0.75)

c. Onsite (0.375) at all times (0.375).

Ref: WNP-2 Tech. Spec., pg. 6-1.

8.5 According to Tech. Specs., in order for the Fire Suppression
Water System to be considered operable, three (3) conditions
must be met. State these conditions. (3.0)

pumping from the circulating water basin, or one dieseldriven pump pumping from the secondary water supply tank, with their discharge aligned to the fire suppression header.

(1.0)

b. Two separate fire water supplies, the recirculating water pump house inlet basin and the secondary water supply tank.

(1.0)

c. An OPERABLE flow path capable of taking suction from the circulating water pump house inlet basin and the secondary water supply tank and transferring the water through distribution piping with OPERABLE sectionalizing control or isolation valves to the yard hydrant curb valves, the last valve ahead of the water flow alarm device on each sprinkler or hose standpipe and the last valve ahead of the

deluge yalve on each deluge or spray system required to

(1.0)

a. At least two of the three OPERABLE fire suppression pumps

Ref: WNP-2 T.S. pg. 3/4 7-18.

be OPERABLE (O.S)

8.5

- 8.6 According to the Limitations stated in the Operating Procedures for the <u>Reactor Core Isolation System (RCIC) (SOP 2.4.6)</u>:
 - a. What must you do to manually isolate RCIC when system initiation is not sealed in? (0.75)
 - b. Under what condition(s) can the auto flow controller (RCIC-FIC-600) be removed from automatic? (0.75)

to get value fair.

8.6 a. Close the isolation where the secret with the secre

8.6 a. Close the isolation valves using their respective control switches (375) (0.75)

b. Only with permission of the Shift Supervisor. (0.75)

Ref: WNP-2 SOP 2.4.6, pg. 2 and 3 of 28, respectively

is amore says "in operator's judgement" if andedate refer to standing Orders

Must Ref.
Standing order
to use creatur
judgement.

8.7	Wit	th regard to certain shift personnel and their functions:	is to state
	a.	There must be two (2) licensed reactor operators in the Control Room at all times (TRUE or FALSE)?	100 tions e. C. assur (0.5) &
	b.	During new fuel handling operations, a licensed reactor operator must be on the refueling floor (TRUE or FALSE)?	(0,5)
	c.	During what modes of operation shall the Shift Technical Advisor be on shift?	(0.5)
	d.	If, while at power, the <u>Shift Manager</u> is incapacitated, what <u>action(s)</u> should be taken?	(0.75)

8.7 a. False

b. False

c. Modes 1, 2 and 3.

d. The CRS4 or licensed SRO (other than STA) shall assume his duties and immediately advise the Operating Manager.

Ref: WNP-2 Admin. Proc: 1.3.2, pp. 3 (for a and c) and 2 for (d); 6.2.3, pg. 2 for (b).

8.8 According to Standing Order/Night Orders (Admin. Proced. 1.3.1):

a. A break occurs in a RCIC line. Would the following control room instruments provide valid indications (Yes or No)? If "NO", how could you verify the necessary information?



deleto

1) MS-LI 610 2) RHR-FI-603B 3) SLC-LI-601

b. Following each refueling outage, independent verification of the operable status is required for what <u>types</u> of equipment?

(1.0)

delete

a. 1) No (0.2); Use alternate instrument MS-LR-615 (0.3)

2) No (0.2); locally (0.3)

3) No (0.2); locally (0.3)

(145)

b. Safety related (0.5) and fire protection equipment (0.5)

(1.0)

Ref: WNP-2 Admin. Proc. 1.3.1, pp. 7 and 3, respectively.

8.9 According to Monthly Operational Bulletins:

colled to attention of all sies .

a. What would occur if RHR valves V-8, 9, 6 and RHR-27A were opened?

(1.0)

telelo.

How did the failure, on two shifts, to check chart movement on wetwell level recorder CMS-LR/RR-4 contribute to loss of wetwell level?



c. Why is it important to ensure that <u>local</u> temperature indicators at the <u>nitrogen</u> supply shed and in the reactor building are monitored?

(1.0)

8.9 a. The reactor vessel would be drained to the suppression pool.

(1.0)

delete

b. The recorder had been, in fact, inadvertently de-energized so that annunciator alarm switches activated by the recorder pen were also 0.0.S.

(120)

c. No control room monitors exist. If nitrogen temperature gets too low, nitrogen flow onto a 30 in. dia. containment purge header and onto wetwell and drywell purge liner inside containment could cause failure through nitrogen embrittlement. (0.5)

(1.0)

Ref: WNP-2 Monthly OP Bull: January 1984, pg. 4; April-May, pg. 1; Feb-Mar, pg. 6, respectively.

8.10 With regard to the Emergency Plan Implementation Procedures, which of the four emergency classes would you place the following:

(2.0)

1) An ATWS

2) HCTL exceeded

- Volcanic ash fallout severe enough to warrant plant shutdown
- 4) Transport of a contaminated individual offsite

8.10 (0.5 ea.)

(2.0

1) Alert

2) Site Area Emergency

3) Alert

4) Unusual Event

Ref: WNP-2 EPIP: 13.1.1, pp. 8, 20, 7 of 21, respectively.

Forely Review Copy Reviewed by: Steply J Rejud

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

			Facility:		WNP-2
			Reactor T	ype:	BWR-5
			Date Admi	nistered:_	11/6/84
			Examiner:		I. S. Levy
			Candidate		
INSTRUCTI	ONS TO C	ANDIDATE:			
Staple quare indic at least papers wi	ated in 70% in e	sheet on top of parenthesis a each category	of the answer fter the ques and a final g) hours after	sheet. Pation. The rade of at	ers on one side only. oints for each question passing grade requires least 80%. Examination nation starts.
		Score			Category
25	25			Operati	of Nuclear Power Plant ion, Fluids and dynamics
25	25			6. Plant S and Ins	System Design, Control strumentation
25	25		_		ures - Normal, Abnormal, ncy, and Radiological
25	25				strative Procedures, lons, and Limitations
100				TOTALS	
		Final Grade	- 8		
All work of aid.	done on	this examinati	on is my own;	I have nei	ther given nor received
				Candidate'	s Signature

Reviewd by: Stephylograd STEPHEN J MEJNIAN 11-6-9

Questions and Answers to WNP-2 SRO Exam - 11/6/84

5.0 Theory of Nuclear Power Plant Operations, Fluids and Thermodynamics (25.0)

5.1 Give three (3) reasons why fuel densification is a problem. (2.25)

5.1 (any 3; 0.75 each)

(2.25)

- 1. Local power spikes resulting from axial fuel column gaps.
- Increased linear heat generation rate due to pellet axial shrinkage.
- 3. Cladding collapse at the location of axial fuel column gaps.
- Increased stored energy due to decreased pellet-cladding thermal conductance resulting from increased radial gap size.

Ref: Morris Training Center: Thermo/HT/Fluid Flow (3/83), pg. 9-107

5.2 Your latest computer printout of MFLPD and MAPRAT shows the following values for Regions 1 to 3.

> Region 1 2 3 MFLPD 0.95 1.0 1.05 MAP/RAT 0.92 1.08 1.00

- a. Which, if any, of these values are beyond their safety (1.0)
- b. Why are each of the above limits imposed? (What do they protect against?) (1.5)
- c. Compared to BOL, would the values for MAPRAT at EOL be larger or smaller? Why? (1.5)

- 5.2 a. MFLPD Region 3 (0.5) MAPRAT Region 2 (0.5)
 - b. MFLPD Maintains <1% cladding strain, fuel failure. (0.75)
 - MAPRAT Maintains <2200°F following LOCA, decay heat removal (0.75)
 - c. Larger (0.5); MAPLHGR limit decreases (0.5) since local peaking factor gets smaller as, with exposure, heat transfer is reduced (0.5). (1.5)

Ref: WNP-2 Systems and Procedures, PC, Pg. 16; and MTC Thermo/HT/FF (3/83), pg. 9-66 through 9-76.

5.3 In reference to the reactor water cleanup regenerative heat exchanger, assume the following conditions and, then, perform the calculations.

Conditions:

T inlet from reactor (tube side) = $550^{\circ}F$ T outlet from H_X (tube side) = $250^{\circ}F$ T inlet shell side = $120^{\circ}F$ Tubeside flow rate from reactor = $1300^{\circ}G$ gal/min Shellside flow rate to reactor = $1300^{\circ}G$ gal/min

Calculate (and show all work):

c. The maximum temperature of water going back to the reactor if the flow back to the reactor were decreased from 1,300 gpm to 800 gpm due to a leak in the tube side of the
$$H_{\rm X}$$
. (1.0)

= 1300 gal/min x 60 min/hr x 8.33 lbm/gal

$$= 1.949 \times 10^8 \text{ Btu/hr.}$$
 (1.0)

c. 550°F as follows:

$$T_{max} = Q/M + 120$$

$$= \frac{1.949 \times 10^8 \text{ Btu/hr}}{800 \text{ gal/hr}} \times \frac{1}{60} \frac{\text{hr}}{\text{min}} \times \frac{1}{8.33} \frac{\text{gal}}{\text{lbm}} \times \frac{1}{1 \text{ Btu}} \frac{\text{GF}}{\text{lbm}}$$

but cannot be greater than 550°F (max. T from reactor to inlet)

Ref: Morris, T. C.; Thermo/HT/Fluid Flow (3/83), pgs. 8-40,41.

While at 75% power, the master feedwater controller fails low. Will the NPSH of the recirculation pumps increase, decrease, or remain unchanged? Briefly, explain why.

(1.25)

5.4 Decrease (0.5); reduced subcooling (0.75)

(1.25)

Ref: Morris, T. C.; Thermo/HT/Fluid flow (3/83), pg. 7-96.

£43	5.5	With regard to excess reactivity:	
Reversed by		a. The excess reactivity for a <u>cold</u> , <u>clean</u> , <u>critical</u> reactor is greater than that for the <u>hot</u> , <u>clean</u> , <u>zero</u> <u>power</u> condition (TRUE or FALSE).	(0.5
		b. The excess reactivity for the hot, clean, zero power condition is smaller than that for the hot, full power, equilibrium Xe and Sm condition (TRUE or FALSE).	(0.5
		c. The excess reactivity at EOL is greater than that at BOL (TRUE or FALSE). Why?	(1.25

5.5	a.	True	(0.5)
	b. 1	False	(0.5)
	c.	False (0.5); fuel depletion and fission products increase (0.75)	(1.25)
	Ref:	WNP-2, Reactor Theory Rev. pg. 39.	

		1	À
		1	>
0	el's	N	1
·×	13		
	Year	. 0	•

- 5.6 The WNP-2 reactor is taken to criticality from a cold condition and then placed on an 80 second positive period.
 - a. From control room <u>nuclear</u> instrumentation, <u>how</u> can the operator tell <u>when</u> the heating range has been reached? (Rod position and recirculation are held constant).

(0.75)

b. In which of the following intervals was the heating range entered? <u>Explain</u> the reason for your answer. (Show all work.)

(1.5)

- Interval 1 reactor power increased by a factor of 6 in 143.3 seconds.
- Interval 2 reactor power increased by a factor of 3 in 99.0 seconds
- Interval 3 reactor power increased by a factor of 5 in 128.8 seconds.

(Note: the intervals may not be in sequence.)

- 5.6 a. Operator can notice that <u>period</u> has become longer and that power change on <u>IRMs</u> is leveling off.. (0.75)
 - b. (From P = $Poe^{t/T}$ + T = $\frac{t}{\ln P/Po}$) Interval 2 (0.5); the period has lengthened from 80 seconds. The other intervals have 80 second periods (1.0). (1.5)

Ref: General control room indications; WNP-2, Reactor Theory, pg. 58.

Revenue Light	a.	Whi	ch reactivity coefficient is the <u>most</u> dominant under following conditions:
γ,		1) 2) 3) 4)	During rod drop accident at 15% power Pulling rods at 1% power MSIV closure at 100% power Feedwater controller fails high at 100% power?
	b.	For	"feedwater controller fails high at 100% power," a.
		1)	Give the reason for your answer to a.4) above.
		2)	What will happen to power (increase, decrease, stay the same)?
		3)	What is the approximate value at BOL of the coefficient you gave as your answer to a.4) above?

power? power," a.4) above: above. (1.0)rease, (0.5)the coefabove? (0.5)a. (0.5 for each) (2.0)1) Doppler coefficient 2) Moderator coefficient 3) Void coefficient 4) Void coefficient b. 1) Increase in core subcooling which reduces void fraction whose coefficient has greatest effect on reactivity. (1.0)2) Increase (0.5)3) -1 x 10-3 AK/K/1% void change of the candidate gives the wrong coeff. in a.4) but gives correct value credit should be given (Error (0.5)Ref: Standard Reactor Theory. carried forward) i.e. a. 4) Moderator arelf 6.2) -1×10-4 4/4

(2.0)

7

week of 5.8

Near the <u>end-of-cycle (EOC)</u>, will <u>differential</u> control rod worths near the bottom of the core be <u>lower</u> or <u>higher</u> than those near the top of the core? Why?

(1.75)

(1.75)

Higher (0.5). As fuel burns, control rods must be withdrawn causing flux to peak lower in the core (0.75); and rod worth is proportional to flux² (0.5). (Allow command) should be withdrawn Ref: WNP-2, Reactor Theory, pg. 81.

8

	1	20
	موره	1
8	Ery.	1
	Man	
	1,	

Samarium (the reactor has been operated at a constant power for many days):

a. If reactor power is then <u>doubled</u>, will the new equilibrium <u>Samarium</u> concentration be exactly <u>twice</u> as great (YES or NO)? Explain. (1.5)

b. If the reactor is shut down, initially by a 1% ΔK/K, will the <u>initial</u> effect of <u>Xenon</u> be to <u>increase</u> or <u>decrease</u> the shutdown margin? (0.5)

5.9 a. No (0.5); the equilibrium value of samarium does not depend on flux, and, therefore, it does not depend on power level (1.0).

Ref: WNP-2 Reactor Theory, pg. 87.

b. Increase. (0.5)

Ref: Standard Reactor Theory

5.10 With regard to Delayed Neutrons:



a. In causing fissions, what is the major difference between delayed neutrons and prompt neutrons? (0.75)

b. Explain how and why the value of the delayed neutron fraction, Beta, changes from the beginning of core life to the end of core life. (0.75)

c. Explain the effect on reactor control of the change in Beta with core life. (0.75)

5.10 a. Delayed neutrons have a lower probability of causing fast fission (the "importance" factor is less than 1). (0.75)

Ref: Standard Reactor Theory.

b. Beta will decrease from about 0.007 at BOL to 0.0054

at EOL due to buildup of Pu-239 and depletion of U-235. (0.75)

Ref: Standard Reactor Theory.

c. As beta decreases with core age, reactor period decreases and, therefore, for the same reactivity addition rate, a shorter period and less easy control is obtained at EOL. (0.75)

Ref: Standard Reactor Theory

$$a_v = -1 \times 10^{-3} \frac{\Delta K/\Xi}{K}$$
 voids

$$p = \frac{k(eff) - 1}{K(eff)}$$

$$M = 1/(1-k)$$

$$n = v/(1 + d)$$

$$\tau = (\beta-p)/\lambda_0$$

Table 1. Saturated Steam: Temperature Table

Temp	Alex Press	Sat	pecific Val		Sat	tataaip	The second secon	-	Entrep		
Fahr 1	, Sq. to	Lequet	Evap	V-ipor Va	Liquid h,	Evap	V.sgreet	Suit Limpted by	Even	Value .	fire
37 0° 34 0 36 0 38 0	0 10395	0.016019	3164 7 3061 9 7839 0 2634 1	3304 7 3061 9 2839 0 2634 2	-00177 1996 4 004 5 018	10/4 4 10/1 2 10/2 1	1075 5 1076 6 1077 7 1078 1	0 0155 0 0041 0 0041	2 1/62 2 1/62 2 1/61 2 1/64	2 16A1	34 0 34 0 38 0 38 0
42 8 47 8 44 0 46 0 48 8	0 1314 0 14192 0 15314 0 15515	0.016019	2445 8 2272 4 2112 4 1365 7 1830 0	2445 8 7272 4 2112 8 1965 7 1830 0	10 035 12 041 14 047 16 051	10/10 1060 8 106.8 / 106.6 4	1077 0 1079 3 1.040 7 1081 6 1082 5	0 0142 0 0707 0 0712 0 0321	2 1432 2 1725 2 1217 2 1111 2 1006	2 1534 2 1527 2 1453 2 1453 2 1127	48 8 47 8 44 8 44 8
58 0 57 0 54 0 56 0 56 0	3 17794 0 17165 0 20475 0 27183 0 73843	0 016074 0 016076 0 016078 0 016031	1704 8 1589 2 1487 4 1383 6 1292 2	1704 8 1549 2 1482 4 1383 6 1292 2	18 054 20 057 27 058 24 059 25 060	1045 3 1764 2 1763 1 1061 9 1060 8	1087 4 1084 7 1065 1 1086 0 1086 9	0 0 1 1 9 0 0 4 7 8 0 0 5 1 6	2 0901 2 0794 2 0495 2 0593 2 0491	2 1267 2 11117 2 11 14 2 1079 2 1078	58 8 57 8 54 8 55 8
67 8 64 8 64 8 64 8	0 25611 0 27494 0 29417 0 31674 0 33889	0 016033 0 016016 0 016019 0 016043 0 016046	1207 6 1179 7 1056 5 989 0 926 5	1207 6 11.79 2 1056 5 789 1 926 5	24 050 30 054 31 056 36 054	1959 7 1054 5 1054 3 1055 2	1087 7 1088 6 1789 5 1090 4 1091 2	0 05-5 0 07-93 0 05-17 0 75-70 0 07-08	2 0.341 2 0.791 2 01 72 2 00 94 1 9996	2 07/16 2 07/14 2 07/14 2 07/04	60 0 67 0 64 0 66 0
70 0 72 0 74 0 76 0 78 0	0 36797 0 38844 0 41550 0 44420 0 47461	0 015050 0 015054 0 015061 0 015067	868] 814 7 764 1 717 4 673 8	868 4 814 3 764 1 717 4 673 9	18 75.7 41 (419 41 (41) 44 (41) 46 (40)	1054 0 1057 9 1051 8 1050 7 1049 5	1007 1 1001 0 100 - 8 1001 7 1005 6	0.0745 0.1783 0.0875 0.0875	1 9900 1 9801 1 9708 1 9614 1 3520	2 0545 2 0547 2 05:3 2 04:2 2 04:5	70 0 77 0 74 0 76 0 78 0
80 8 87 0 84 0 86 0	0 50-41 0 51091 0 57702 0 61518 0 65551	0.015077 0.015077 0.015082 0.015087 0.016093	533 3 595 5 560 1 277 5 496 8	631 3 525 3 560 3 527 5 496 8	48 017 10 013 57 019 54 075 56 072	10484 10471 17161 17450 10439	1004 4 1004 3 1004 3	0 00 17 0 7 14 0 10 15 0 10 15 0 10 17	1 94 % 1 91 13 1 97 47 1 91 51 1 9060	20151 20191 20131 20131 20139	87 0 87 0 84 0 86 0
90 0 97 0 94 0 96 0 18 0	0 A7813 0 74113 0 71062 0 84072 0 89356	0015105 0015111 0016117 0016123	468 (411] 416] 397 8 370 9	46.8 1 441 3 416 3 392 9 370 9	58 01 8 62 01 4 62 01 0 64 00 5 64 00 3	1047 / 1041 5 1040 5 10 49 3 1018 7	1107 8 1101 6 1102 5 1103 3 1104 2	01115 01152 01138 01274 01760	18970 18941 18732 18704 18617	7 90% 7 0011 1 9978 1 9876	90 8 97 8 94 6 96 8 98 8
100 8 107 0 104 0 106 0	0 14178 1 00/89 1 06/65 1 1347 1 7036	0-91513Q 0-015117 0-01514 0-015158	150 4 111 1 111 1 79n 16 780 28	3'47 4 311 1 113 1 276 18 280 30	67 000 60 000 71 007 73 99 75 98	1017 1	110% 1 110% 1 110% 8 1107 6 1108 5	01/95 01/11 01/46 01/02	(85 10 1 8344 1 8358 1 877)	1 34/5 1 97/5 1 97/5 1 97/5	100 0 187 0 194 0 196 0
110 8 112 8 114 8 116 8	1 2750 1 7505 1 4279 1 51 13 1 44825	0016165 0016171 0016180 0016188	765 37 751 17 738 21 775 84 714 70	265 19 751 18 238 22 275 85 214 21	77 98 29 58 81 97 81 97 85 97	1011 4 1010 2 1079 1 1077 9	1109 1	01417 01477 01507 01542 01577 01611	1 8188 1 8105 1 8021 1 7218 1 7876 1 7774	1 9676 1 9577 1 2528 1 2480 1 2411 1 9 186	1100
176 6 127 8 124 8 126 8	1 6927 1 7891 1 8901 1 9959 2 1068	0.016,204 0.016,213 0.016,221 0.016,279 0.016,238	203 25 192 94 183 23 174 08 165 45	703 76 197 75 183 74 174 09 165 47	87 97 87 76 91 76 93 76 93 76	1025 6 1074 5 1027 3 1027 2 1021 0	11116 11144 11153 1161	0 1646 0 1640 0 1715 0 1749 0 1783	1 7643 1 7513 1 7513 1 7453 1 7374	1 9119 1 9293 1 9247 1 9202 1 9157	128 6 122 6 124 8 128 8 128 8
138 0 132 0 134 0 136 0 138 0	2 7230 2 3445 2 4717 2 6647 2 7438	0016247 0016256 0016265 0016274 0016284	157 32 149 64 142 40 135 55 129 09	157 33 149 66 142 41 135 57 129 11	97 96 99 95 101 95 103 95 105 95	1019 8 1018 7 1017 5 1016 4 1015 2	1117 8 1118 6 1119 5 1120 3	0 81 7 0 85 1 0 884 0 918 0 195 1	1 7795 1 7217 1 7140 1 7063 1 6986	19117 19068 19074 18980 18937	138 9 132 8 134 8 136 8
140 6 147 8 144 8 146 8	2 8892 3 04 11 3 1997 3 3653 3 5381	0 016293 0 016303 0 016322 0 016322	122 98 117 71 111 74 106 58 101 68	123 00 117 22 111 76 106 59 101 70	107 95 109 99 111 95 113 95 115 99	1014 0 1017 9 1011 7 1010 5 1009 3	1122 0 1122 8 1123 6 1124 5 1125 3	0 1985 0 2018 0 2051 0 2084 0 2117	1 6910 1 6534 1 6759 1 6684 1 6610	1 8895 1 8852 1 8810 1 8769 1 8727	148 8 147 8 146 8 146 8
156 8 152 8 154 8 156 8	3 71 84 3 9065 4 1025 6 3068 6 51 97	0016343 0016353 0016363 0016374 0016386	97 05 92 66 88 50 84 56 80 82	97 07 92 68 88 52 84 57 80 83	117 95 119 95 121 95 123 95 125 96	1008 2 1007 0 1005 8 1004 6 1001 4	1126 1 1126 9 1127 7 1128 6 1129 4	0 2150 0 2161 0 216 0 2748 0 2781	16536 16463 16390 16318 16245	1 8686 1 8646 1 8666 1 8566	156 8 152 8 154 8 156 8
# : # : # :	4 7414 4 9/77 5 7174 5 4673 5 7223	0.016.195 0.016.417 0.016.428 0.016.440	77 27 73 90 70 70 67 67 64 78	77 29 73 97 70 77 67 68 64 80	17/76 17776 13176 13176 13397	100.° 7 1001 0 999 8 998 6 997 4	11 10 7 11 11 0 11 11 8 11 32 6 11 33 4	0 7 11 1 0 7 14 4 0 2 3 7 7 0 2 40 9 0 2 46 1	16174 16103 16017 15961 15892	8487 8448 8409 8371	160 S 167 S 164 S
178 0 172 0 174 0 176 0	5 9976 6 2736 6 5656 6 8690 7 1 840	0016451 0016463 0016474 0016486 0016498	62 04 59 43 56 95 54 59 52 35	62 06 59 45 56 97 54 61 52 36	137 97 139 98 141 98 143 99 145 99	996 2 999 0 993 8 992 6 991 4	11 34 7 11 35 0 11 35 8 11 36 6 11 37 4	0 74/3 0 7505 0 7517 0 7568 0 2600	1 5A27 1 5753 1 5684 1 5616 1 5548	1 83333 1 8795 1 8758 1 8771 1 8184 1 8147	171

"The states shown are meta-stated

Table 1. Saturated	Steam:	Temperature	Table-Co	ntinued
Specific Valume		Enth.iig		

Temp	Abs Press	Su	ecific Val	ume Steam		(mh.np	,		Entrap		
f _{Altr}	Sea in	Sat Liquid V,	funp vie	Vapor	Loquet	Leag	V.ipni	t square	free	\$ at \$ 15 m	1.00
180 0 187 8 184 0 186 8 188 0	7 5110 7 850 8 701 8 568 8 947	0016510 0016527 0016514 0016547 0016559	50.71 48.177 46.112 44.383 47.621	50 27 18 187 46 749 44 400 42 638	148 30 150 01 157 01 154 02 156 01	979) 7 989 0 989 0 985 5 985 1	11/8 ? 11/9 0 11/9 4 11/0 5 11/4]	0.2631 0.263 0.263 0.263 0.273 0.273	154#0 15411 15314 15719 15213	1 #1111 h075 6-317 4-91	
198 6 197 6 194 8 196 8	9 340 9 747 10 168 10 605 11 958	0 016572 0 015585 0 01558 0 01661 0 016624	40 941 39 317 37 808 36 348 34 954	40 95 / 39 154 37 874 36 364 38 970	158 01 160 05 167 05 164 06 166 08	984 987 8 981 6 980 4 979	1142 1142 9 1141 / 1144 4 1145 2	0 2787 0 2818 0 2819 0 2879 0 2910	15148 15092 15017 14957 14888	1 7914 1 7919 1 7865 1 7831 1 7738	190 S 197 s 191 0 196 0 196 0
796 6 796 6 798 6 217 8 214.8	11 526 12 512 11 568 14 676 15 901	0 015417 0 01554 0 0155719 0 015747	33 627 31 135 28 862 25 787 24 878	13 6 39 31 151 78 8 78 26 799 24 894	168 09 177 11 176 14 180 17 184 70	9// 9 9// 8 9/0 1 96/ 8	1145.0 1137.5 1149.0 1150.5 1152.0	0 7040 0 1001 0 1041 0 3171 0 3181	1 48.74 1 15/9/ 1 45/1 1 4447 1 4323	1 7544 1 7518 1 74-7 1 7568 1 7505	200 0 204 0 208 0 212 9 214 0
278 6 278 6 278 6 232 6 236 8	17 184 18 556 20 015 21 567 23 216	00157/5 0015805 0015814 0015864 0016895	21 111 21 529 20 056 18 701 17 454	23 148 21 545 20 073 18 718 17 471	188 77 197 27 196 31 200 35 204 40	964 8	1151 4 1154 5 1156 3 1157 8 1159 2	0 3741 2 1390 3 1152 0 1417 0 1474	8701 2081 3061 3842 3725	1 7447 1 7340 1 7170 1 7140 1 7140 1 7201	770 0 221 0 278 0 237 6 236 0
744 8 744 8 248 0 252 8 256.0	24 968 26 826 28 /46 30 883 33 091	0 016926 0 016958 0 016990 0 017027 0 017055	15 104 15 743 14 754 13 358 12 520	16 321 15 250 14 281 13 375 12 538	208 45 212 50 216 56 220 62 224 69	99/ 919 9 916 8 941 4	1160 6 1167 0 1161 4 1164 7	0 1513 0 3541 0 1643 0 1765 0 1761	13400 13251 131/0 13/54 13/54	17147 17095 17578 16977	248 8 214 8 748 8 757 8 256 8
254 6 254 6 258 6 277 6 276 6	35 477 37 874 40 500 41 747 46 147	0 01/0A9 0 01/15/ 0 01/15/ 0 01/15/ 0 01/15/	11 745 11 025 10 358 4 718 9 162	11 752 11 042 10 175 2 755 1 180	778 76 737 83 731-71 740 74 765 QB	918 6 911 9 911 1 9 111 1 9 111 1 9 111 1	1167 A 1168 / 11/00 11/1 7	0 1819 0 18/6 0 1917 0 1947	1 1041 1 7911 1 7873 1 7715 1 7607	1 6 M A 1 6 M A 1 6 M A 1 6 M A	764 6 764 6 268 8 277 8 276 9
798 6 784 6 788 0 797 0 796 8	49 700 57 41 4 55 795 59 350 63 084	001/36 001/30 001/34 001/38 001/41	8 427 8 1780 7 501 14 7 7 301 6 8259	8 644 8 1453 7 6407 7 7475 6 8433	243 17 251 1 251 5 265 6	9111/ 911/ 9159 9130	11714 11750 1176.7 11774 11786	0 417.1 0 417.1 0 476.1 0 476.1 0 431.7	1 7'61 1 7 115 1 2 116 1 2 186 1 2 0 8 2	1 6400 1 6400	790 8 783 6 783 6 797 8 796 8
396 0 386 6 386 6 312 8 315 8	67 005 71 119 75 413 79 953 84 688	0 01 745 0 01 749 0 01 753 0 01 757 0 01 761	6 4483 6 0755 5 7655 5 4566 5 1673	6 4658 6 11 10 5 78 10 5 4742 5 1849	269 7 271 8 278 9 287 1 286 3	910 0 907 0 904 0 901 0 897 9	1179 7 1180 9 1187 0 1187 1	0 41/2 0 44/5 2 44/9 0 4533 0 4586	1 14/4 1 18/7 1 16/6 1 15/6	6151 4301 4309 4167	229 6 301 0 208 0 312 6 316 6
124 0 124 0 126 0 132 0 132 0	89 543 54 826 100 745 105 907 111 820	0 01 746 0 01 770 0 01 774 0 01 779 0 01 783	4 8961 4 6418 4 #030 4 1/88 3 9681	4 91 38 4 6595 4 4208 4 1966 3 9859	790 4 204 6 298 7 302 9 302 1	8'11 6 8'11 6 888 5 885 3 882 1	1185 Z 1186 Z 1187 Z 1188 Z 1189 1	0.4640 0.4647 0.4745 0.4798 0.4850	11477 11178 11790 11133 11986	14114 1+0/1 1+0/5 15941 15916	170 0 174 0 174 0 174 0 117 0
346 6 346 6 346 6 352 6 354 6	[17 997 174 430 131 142 138 138 145 424	0 01 787 0 01 792 0 01 797 0 01 801 0 01 806	3 /699 3 5834 3 40/8 3 2423 3 0863	3 7878 3 601 3 3 4258 3 2503 3 1064	311 3 315 5 315 7 323 7 328 1	878 8 875 5 877 7 868 9 863 5	1190 1 1191 0 1191 1 1192 7 1193 6	0 4907 0 4954 0 5006 0 5058 0 5110	10700 17894 13797 10:05	15857 15819 15204 15763 15721	140 0 144 0 146 0 157 0 256 0
368 6 364 6 368 6 377 6 377 8	153 010 160 903 169 113 177 648 186 517	0 01411 0 01816 0 01821 0 01826 0 01831	2 9392 2 8002 2 6691 2 5451 2 4279	2 9573 2 8184 2 6873 2 5633 2 4462	337 3 336 5 340 8 345 0 349 3	862 1 858 6 855 1 851 6 848 1	1194 4 1195 2 1195 9 1196 7 1197 4	0 5161 0 5217 0 5763 0 5314 0 5365	1 0517 1 0424 1 0232 1 0240 1 0148	15678 15637 15575 15554 15513	260 8 364 8 366 0 377 8 376 6
386 6 384 8 388 8 252 8 398 8	195 779 205 294 215 220 225 516 236 193	0 01836 0 01842 0 01847 0 01851 0 01858	2 31 70 2 21 20 2 11 76 2 01 84 1 9291	2 3353 2 2306 2 1 311 2 0369 1 9477	3536 3579 3677 3665 3708	814 5 810 8 81/7 833 4 879 /	1176 0 1196 7 1199 3 1179 9 1200 4	0 5414 0 5466 0 5516 0 5567 0 5617	1 0057 0 9966 0 9876 0 9786 0 9696	1 5473 1 5412 1 5132 1 5357 1 5313	254 8 254 8 288 8 292 8 292 8
404 0 404 0 408 0 417 0 418 6	247 254 258 725 270 600 287 894 295 617	0 01864 0 01870 0 01875 0 01881 0 01887	8444 7640 6877 6152 5463	1 76-30 1 78-77 1 706-4 1 6 3-40 1 56-51	375 1 379 4 383 8 348 1 392 5	875 9 877 0 818 7 814 7 819 2	1201 0 1201 5 1201 9 1202 4 1202 8	0 106/ 0 5/1/ 0 5/46 0 1416 0 1866	07518	1 52/4 1 5/14 1 5/19 1 5/15/ 1 5/18	+00 0 +01 0 +02 0 +17 0 +16 0
428 8 424 8 478 8 432 8 432 8	308 /80 327 391 336 463 351 00 366 03	0 01900 0 01906 0 01913 0 01913	1 4808 1 4184 1 3591 1 30766 1 74887	1 4997 1 4374 1 3782 1 32179 1 26806	376 9 401 3 405 7 410 1 414 6	80A 2 AO: 7 /18 0 /93 1 789 /	1203 5 1203 5 1203 7 1204 0 1204 2	0 1915 0 1964 0 6063 0 6112	0 7145 0 90// 0 8790 0 8903 0 8816	1 1040 1 1017 1 1004 1 2466 1 4928	478 8 478 8 478 8 472 8 412 8
640 0 644 0 640 0 452 0 458 0	381 54 397 54 414 09 431 14 646 73	0 01926 0 01933 0 01940 0 01947 0 01954	1 19761 1 14874 1 10717 1 05764 1 01518	1 21687 1 16816 1 17152 1 07711 1 03472	4190 4:35 4/80 4125 44/0	784 (I 781 (776 / 777 (767 8	1,704 4 1,704 6 1,704 7 1,704 8 1,204 8	0 6161 0 6710 0 6759 0 6178 0 6356	0 8729 0 8643 0 8557 0 8471 0 8185	1 1890 1 485 1 1815 1 47/8 1 47/8	444 5 444 5 448 6 457 8 458 8

Table 1	Saturated	Steam	Ta	T-	hin 6	

-	Ans Press	- · ·	able 1. S	aturated	Steam: T			e-Con	tinued			
femp	I ft per	Sit		S at	Ş.,	it Enth,	all a		× ,1	\$ percent	* "	h.a.
Lahi	Sq in	* i	d Fv.10	W-same		un for	p. V.que		1900			8.49
468 6 464 8 463 6 477 8 475 8	4/6 A/ 485 '-6 405 A/ 5/4 6/ 545 11	0 0136 0 0136 0 0136	0 5/461 0 0 1 1 AR 0 8 345	0.954.74 0.7186.7 0.883.79 0.84950	63; 641. 67.5; 459;	7637 7-86 7-7-10 7-10 7-10	1:04 5	9	6.17-1 6.07-1	1 4 54 1 4 1 1 1 4 1 1 1 1 4 1 1 1 1 4 1 1 1 1 4 1 1 1 1	1 4 15 1 24 1 1 24 1 1 45 2 1 45 2 1 45 5	464 6 464 8 477 0
498 0 404 8 488 0 492 0 496 0	474 4 44/ 2 610 10 611 01 656 61	0 0.70 × 0 0.70 × 0 0.70 × 0 0.70 × 0 0.70 ×	0 /6413	0.8(7)7 () /86/2 0.75/3 0.77820 0.70100	41 4 1 4/11 4/11 4/81 4/81	214 7 174 7 174 6	1701 a 1701 5	0	6 15 1 6:15 1	0 1471	1 15 14	401
500 0 504 0 506 0 517 0 516 0	6,80,86 705,78 731,40 757,72 784,76	0.77643 0.07153 0.07167 0.07177 0.07181	0 67738 0 60530 0 58718	0.47492 0.64791 0.67592 0.60, 29 0.4074	487 9 497 7 497 9 507 1	7040 7017 6387	12017	0	6419 1 6787 1 7716 (7/481 97/57 97/57 97/45 97/45	(411) (429) (429) (421) (431)	500 0 504 0 508 0 517 0 516 0
524 8 524 8 528 6 532 8 336 8	417 53 841 04 870 31 900 34 931 17	0 0 7 102 0 0 2 102 0 0 2 1 1 2 0 0 2 1 2 3 0 0 2 1 3 4	0 47843 0 47843	0 5145 A 0 51755 0 51755 0 50070 0 48757	51: 0 51: 0 521 8 524 8 511 7	6/55	11547	20	/147 / //31 (1 701 1 1 - · · 4 1 - · · 4	1 41 16 1 41 19 1 41 19 1 40 17 1 40 17	520 0 521 0 520 0 527 0 527 0
548 8 548 8 548 6 557 0 556 8	962 79 995 27 1078 49 1062 59 1097 55	0 02157 0 02157 0 02169 0 02194	0 44167 0 42677 0 61048 0 39479 0 37966	0 44834 0 44834 0 41217 0 41564 0 40160	116 9 116 9 117 9 117 9	651 3 645 0 618 5	(158) (151) (151) (151 9 (159 2	0	1474 0 1474 0	164/7 161/3 161/3 161/1 162/2	1 1754 1 1757 1 1757	546 6 544 0 518 0 552 0 558 0
168 0 164 0 168 0 172 0 176 0	1133 38 1170 10 1207 72 1246 26 1285 74	0 0770/ 0 0771 0 07715 0 07749 0 07764	0 36507 0 15099 0 33741 0 32479 0 31162	0 38/14 0 3/320 0 359/5 0 346/8 0 33475	567.4 567.5 577.2 578.1 583.7	6185	1187 7 1184 1 1184 5 1187 7 1180 9	0 7	1725 O	15, 12 15,50 15,859 15,756	13615	160 0 164 0 168 0 177 0 176 0
580 8 584 8 588 8 582 0 586 8	1376 17 1367 7 1410 0 1453 3 1497 8	0.02279 0.02795 0.02111 0.02328 0.02345	0 29937 0 28753 0 27608 0 26499 0 25425	0 37216 0 31048 0 27919 0 28827 0 27770	589 (501 6 600 1 605 7 611 4	587 9 587 6 574 7 566 8 558 8	1179 0 1174 9 1174 8 1177 6 1170 2	0 7	978 O	5473 5480 5380 5380 5293	344g 3507 3454 3470 3375	500 0 584 0 584 0 597 0 598 0
600 0 504 0 603 0 617 0 516 6	15412 (5897 16173 16861 17359	002402 02 002402 02 002422 02	4:84 076 3174 075 2154 074 1447 073 0516 077	757 796 865	6171 6279 6788 6188 6408	547 / 11 5116 11 5747 11	67 7 65 1 67 4 50 5	0 #134 0 #187 0 8710 0 8714 0 #148	05124	110	19	507 0 601 0 628 0 617 0 616 0
578 8 574 6 629 8 532 8 638 6	1746 9 1811 0 1917 6 1947 9 2007 8	00'489 01 007518 01 007519 01	76.15 0.776 8/17 9/1. /880 0.70 /044 0.195 6776 0.186	775 104 58J	517 1 517 7 557 7	4 W. S. 11:	47 # 16 1 47 7 3# 1	0 #103 0 #1 # 0 #114 0 #114 0 #678	0 17.49	1 101 1 799 1 799	11	670 0 674 0 678 0 617 0 618 0
640 0 640 0 637 0 636 0	2759 9 2118 3 2178 1 2239 2 2301 7	007657 01	5427 0186 4644 0177 3876 0165 3124 0157 2387 0151	769	685 9 697 9 700 0	411 1 111 418 7 111	13 / 13 0 74 0 18 /	0 8746 0 8746 0 8868 0 8868	0 41 14 0 4015 0 1493 0 3767 0 3637	1.774	19	640 0 640 0 640 0 652 0 652 0
668 8 664 8 646 0 677 0 678.0	2365 7 2431 1 2198 1 2546 6 2636 8	0 0 2 8 1 0 1 0 0 0 0 2 9 1 1 0 0 0	16A3 0144 0947 0137 0279 0130 9514 0124 1/99 0117	157 187 124	7149 7229 7115 7407 7492	3577 110 3571 109 3457 108	07 0 00 6 1: 5 15 9	0 8995 0 9054 0 9137 0 9212 0 9287	0 1502 0 1351 0 1210 0 1054 0 2892	1 249	6	664 0 664 0 664 0 677 0 676 6
600 0 604 0 602 0 602 0	27086 27821 28574 29345 30134	003114 00: 003204 000 003313 000	1349 0104 1349 0104 1395 0097 13797 0091 1916 0083	163 199 10	768 2 778 8 790 5	2687 104 (4) [10]	58 5 58 4 67 0 13 6 7 7 2	0 9365 0 9447 0 9535 0 9434 0 9749	0 2720 0 2537 0 2337 9 2110 0 1841	1 208	6 4 2	100 1 100 1 100 1 100 1 100 1
700 8 162 8 164 9 175 S 185 AJ*	3094 1 1115 5 1177 7 1174 1 3208 2	001874 003 004108 003 004427 003	1857 0 075 1173 0 064 1137 0 061 1304 0 057 1000 0 050	97 / 90 30	877 4 815 0	1727 99 144 97 107 95 61 93	5 2	0 9901 1 0006 1 0169 1 0129 1 0612	0 1490 0 1245 0 0876 0 0577 0 0000	1139	0 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	700 0 707 0 784 0 703 47*

*Critical temperature

Table 2: Saturated Steam: Pressure Table

Ans Press LD/Sq in	lemp fahr I	Sat Liquid	(vap		Sat Liquid h j	formatpy Evap	Sal Vapor	S at Liquid S a	Evap	S at Vacor	Ans Press
0 50063 0 75 0 30 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1	17.018 50.371 70.586 101.74 102.24 173.71 217.00 213.03	0.014027 0.014017 0.01417 0.01417 0.015407 0.0167 0.0167	1 (07 4 1 11 5 641 5 131 70 73 515 18 404 76 782 26 7/4	1:07 4 17:5 5 64:5 111:4 13-12 18:4:0 24:799 16:290	0 000) 27 (82 47 - 11 10 70 161 / 6 180 17	1075 5 1060 1 1018 6 1076 1 1000 9 987 1 989 7	(0.55 (m)/4 (0.6.1 (10.54 (1.1) (1.1) (1.1) (1.1) (1.1) (1.1)	0 mmn 0 m 12 0 m 12 0 m 13 0 m	71877 71877 71874 1-4174 1-4074 1-4074 1-4447 1-4447	2147 2047 2047 1013 1013 1014 2014 2014 2014 2014 2014 2014 2014	0 20055 2:1 0 10 10 10 0 10 0 14 556
26 6 38 0 48 6 56 6 76 6 76 0 76 0	227.76 250.34 26.7.25 281.02 27.77 302.93 31.2.04 320.28	0.015814 0.017029 0.017151 0.017274 0.017383 0.017482 0.017573 0.01759	20 070 13 7.46 10 4794 \$ 494,7 7 1562 6 1875 5 4536 4 8779	20 087 11 /436 10 4965 8 5140 7 1716 6 2050 5 4711 4 8953	196 77 718 9 718 1 750 2 767 7 787 1 290 7	945 7 9116 9116 9114 9114 900 9	11.4 1 11.4 1 11.7 8 11.4 1 11.7 6 11.80 6	0 1/54 0 16/2 0 17/1 0 41/2 14/2/3 0 41/1 0 45/14	1 3067 1 3313 1 .814 1 2474 1 2167 1 1705 1 1675 1 1470	1 5705 16 705 16 705 16 705 16 100 16 100 16 100 16 100	70 8 70 8 40 0 50 8 60 0 70 0 80 0
106 6 110 2 120 8 130 9 140 8 150 8 170 8 170 8	327 82 334 79 341 27 347 33 351 04 358 43 361 55 368 42 373 08 377 53	0 01871 0 01871 0 01877	4 4113 4 0106 3 7097 3 4164 1 7010 7 9948 7 8155 2 6556 2 5179 7 3847	4 4110 4 0184 3 7275 3 4544 3 2170 3 0139 2 6336 2 6738 2 5312 2 4030	27/8 5 30/5 8 31/2 6 31/9 0 3.50 33/6 13/6 13/6 13/6 13/6 13/6 13/6 13/6	887 4 887 1 877 8 877 8 847 8 849 0 849 0 850 7 846 7	1187 2 1188 9 1190 4 1191 7 1191 0 1195 1 1196 0 1196 9 1197 6	0 4711 0 1017 0 1017 0 1141 0 1141 0 1744	11.44 1115 1767 1785 1761 1754 1015 1017	(5077 1 5150 1 5877 1 5877 1 5675 1 6675 1 6671 1 5571 1 5571 1 5178	100 8 100 0 170 8 130 9 130 9 150 8 150 0 175 0
794 8 216 8 279 8 238 6 246 8 256 8 268 8 278 8 268 8 278 8	JR1 80 185 91 189 88 J91 70 J97 79 400 97 404 44 407 80 411 07 414 25	0 01845 2 0 01855 2 0 01855 2 0 01860 1 0 01865 1 0 01870 1 0 01875 1	7579 77991 84909 87452 75548 69137 63169	7 '9/1 / 18717 2 '98-2'9 7-18-6 7-18-6 18417 17-18 7-1019 15-00-9 15-00-9	164 4 157 7 168 7 168 7 176 1 176 1 177 7 181 6 187 1 189 6	#11: 4 #15: 4 #11: 8 #2: 8 #2: 6 #1: 5 #1: 5 #1: 5 #1: 5 #1: 5	1176 1 1176 1 1776 1 1797 5 1797 5 1791 1 1791 5 1791 5 1791 5 1791 5 1791 5	0 114 0 114	11415 0 1011 9 1614 9 165 9 165 0 165 0 165 0 161 0 161	5174 5174 5174 5174 5175 5177 5177 5177	700 0 210 0 210 0 210 0 210 0 210 0 210 0 210 0
100 6 150 0 400 0	41/35 431/33 444 60	0 01879 1 0 01912 1 0 01934 1	52388 30642 14162	54274 132554 16095	394 0 409 8 424 2	808 9 794 2 780 4	1207 9 1204 0 1204 6	0 5882 0 5059 0 6217	0 9223 0 8909 0 8630	1 5105 1 4768 1 4847	300 0 350 0 400 0
458 8 588 9 558 9 608 9 858 8 708 8	456.78 46.701 476.94 486.70 494.89 503.08	001975 001975 001776 007011 007012 007012	1 012:4 0 00/87 0 82:81 0 74%6/ 0 63505	0 97/67 0 841// 0 769/5 0 70843	417 3 449 5 460 9 471 7 481 9 491 6	767 5 751 3 711 3 712 0 710 7	1702 # 1704 7 1704 3 1701 7 1707 8 1701 4	0 4 150 0 12 12 0 14 1 0 14 1 0 14 1 0 14 1 0 14 1	0.81/8 0.8128 0.7916 0.7/18 0.7557 9.7377	17.4 12.1 12.1 12.8 12.8 13.04	116 2 519 0 512 9 607 0 650 7
758 8 898 9 858 9 980 8 990 8 100 8 100 8 1108 6 1158 8 1208 9	510 84 518 71 575 74 511 75 518 19 518 19 556 78 561 82 567 19	0.07049 0.07047 0.07107 0.07173 0.07177 0.07177 0.07174 0.07273	0 58880 0 53807 0 5117/ 0 4798 0 44964/ 0 1/4 6 0 44904/ 0 1/861 0 35459 0 34013	0 56.4% 0 5 1 102 0 5 000 1	500 9 500 8 514 4 526 7 515 7 542 6 550 1 556 8 571 9	679 6 679 5 667 7 667 7 667 7 670 7 671 7 671 7 671 7	1/00 / 100 8 100 0 100 4 100 4 100 4 100 1 100 1	0 /0/2 0 /11/ 0 /10/ 0	07710	1 2" 12 1 41 47 1 51 4 1 51 7 1 7 7 1 7 7 1 7 7 1 14 4 1 14 4	758 8 #33 8 #33 8 #30 8 #56 9 #56 9 #56 8 #56 8
1250 0 1350 0 1450 0 1450 0 1550 0 1550 0 1650 0 1450 0	577 38 577 42 582 32 587 07 596 20 600 59 604 87 609 05 613 13	0 07750 0 07769 0 07769 0 07769 0 07769 0 07766 0 07766 0 07766 0 07766 0 07407 0 07407	0 32306 0 30772 0 79250 0 7/871 0 26542 0 25372 0 24234 0 23159 0 22141 0 21178	0 34546 0 37991 0 31537 0 31178 0 28911 0 27719 0 24545 0 24551 0 23607	5788 585 597 5988 605 3 514 7 624 2 636 5	6018 5746 5746 5765 6574 5584 5594 5111 5277	11 #2 6 11 #0 7 8 11 7 7 8 11 7 7 8 11 7 0 7 4 11 64 64 11 54 86	0 7790 0 1943 0 7906 0 796 0 8076 0 8185 0 8127 0 8150 0 8109	05850 7573 0567 0577 0578 0578 0567 0497 04867	17439	1750 0 1750 0 1750 0 1750 0 1750 0 1750 0 1750 0 1750 0 1750 0
1758 8 1858 8 1858 8 1958 8 1958 8 2008 8 2108 8 2108 8 2108 8	61712 62102 62456 63272 63580 64276 64945 65589	0 02450 0 02472 0 02472 0 02517 0 02517 0 02565 0 02565 0 02777 0 02777	0 20263 0 17199 0 18558 0 1761 0 16766 0 1686 0 1787	0 22713 0 71561 0 71052 0 70278 0 109,40 0 18831 0 1/5/11 0 16277 0 16476	647 5 618 5 644 5 666 3 477 1 581 8 605 7 707 7 719 0	1111 5018 6026 6852 6156 7 116.7 116.7 116.7 184.8	1155 6 1157 1 1149 0 1145 0 1147 0 1118 1 1110 5	0 \$167 0 8470 0 8472 0 8572 0 8574 0 8674 0 8677 0 8677 0 7011	0 1745 0 4667 0 4561 0 4159 0 4158 0 6754 0 1848 0 1840 0 1840	1 11 2 4 1 20 2 9 1 10 10 1 24 1 1 2 4 1 1 2 4 1 1 2 4 1 1 3 4 0 1 4 6 0 1	1750 0 1860 0 1950 0 1950 0 1950 0 1960 0 1760 0 1760 0
7546 6 2400 6 2758 8 2466 6 7560 6 2000 6 2100 6 2700 8 2206 2*	668 11 673 71 679 53 689 96 690 72 695 33 700 78 705 08 705 47	0 02849 0 02918 0 03029 0 01114 0 01262 0 01428 0 03417 0 05028	0 19299 0 03177 0 08165 0 07171 0 06158 0 05073 0 03771 0 01191 9 00000	0 1 1068 0 12110 0 11174 0 10305 0 09470 0 08500 0 07452 0 05663 0 05078	711 / /44 5 /5/ 3 /7/ 0 / /85 1 /80 1 /80 8 /5 5 906 0	9:16 1:76 31:1 28:1 25:1 218:4 169 3 161 00	10% 1 1 108 2 0 105 5 8 103 9 8 10.70 3 993 3 911 6	0 71 19 0 71 19 0 71 6 0 94 6 0 97 8 0 97 8 1 73 5 1 73 5 1 73 5 1 73 5	0 1240 0 2491 0 2491 0 2491 0 1440 0 1460 0 1460 0 1460	1 7115 1 758 1 973 1 519 1 173 1 0832 1 0612	7400 0 7500 0 7400 0 7430 0 7500 0 1017 0 1100 0 1700 0 1700 0

*Critical pressure

LANGDON - COMMENTS

6.0 Plant System Design, Control and Instrumentation (25.0)

6.1	Wit	h regard to the <u>Vessel Instrumentation</u> :	
	/a.	For what specific condition(s) is the Fuel Zone Range level indicators calibrated?	(1.0)
	b.	For the Narrow Range Level Indicators, MS-LIS-24A,B,C & D:	(2.0)
		 Where are they located in the plant? To what systems/components do they send signals? At what levels are these signals initiated? What system/component action is initiated? 	
	√c.	How is the signal for jet pump flow generated in an individual (non-calibrated) jet pump?	(1.0)
6.1	vá.	Saturated steam conditions at 0 psig in the vessel and drywell with <u>no</u> jet pump flow.	(1.0)
	ъ.	1) Located in Reactor Building, 522' level.	(0.5)
		2), 3), and 4):	
		 RCIC/RCIC turbine; at level 8; shut steam supply 	(0.75)
		 RPS; level 3; scram and NSSSS Group 5 and 6 isolations 	
	·c.	Pressure, at pressure tap on pump throat, is compared to a common jet pump discharge pressure sensed at the core inlet plenum area by the SLCS injection line to develop a ΔP signal.	(1.0)
	Ref	WNP-2, Systems and Procedures: NBI, pgs. 5, 14 and 9, respectively.	(1.0)

With regard to Process Radiation Monitoring:

va. The main stream line radiation monitoring system will initiate condenser isolation (via AR-V-1) when appropriate channels and their trips are activated. What are these channels and trips?

(1.0)

What type of detector (G-M, etc.) is used in the following radiation monitors:

(1.5)

Rx Building stack extended range
 Off-gas post treatment

3) Circulating water effluent?

vc. Which of the monitors, in b. above, will initiate system isolation or trips?

(1.0)

6.2 va. Channel A or C; HI HI or Inop.

(1.0)

1) Beta scintillation GM (0.5)

(0.5)

3) Gamma scintillation

(0.5)

c. (0.5 each): 2,3

(1.0)

Ref: WNP-2, Systems and Procedures: PRM, pg. 7; 5, 3, 3; and 3, respectively.

6.3 With regard to the Emergency Diesel Generators:

too deliber b. Describe the overspeed trip mechanism (including its location, its major components, and how it initiates an engine trip).

(2.0)

C. What is the purpose of the soak back pump?

6.3 a. (1) Bus SM-3 dead (0.3) or TR-S undervoltage (0.3)

2) TR-B undervoltage (0.3)

3) SM-8 undervoltage (0.3)

4) K98B (containment high pressure or reactor low water level - Level 1) (0.3)

b. Located in the camshaft counterweight housing (0.5).; it consists of a flyweight held by a tension spring. When engine exceeds set limit, spring tension is overcome by centrifugal force acting on the flyweight, permitting an outward movement of the flyweight which actuates the trip lever. This causes latching the injector rocker arm in the depressed position, preventing fuel injection into the engine (1.5). (2.0)

vc. To provide oil to the turbocharger for prelubrication. (0.75)

Ref: WNP-2, Systems and Procedures: DG, pg. 62; Fig. 14; and Fig 8c and pg. 22, respectively.

6.4 With respect to the Automatic Depressurization System (ADS):

va.	What	ADS	controls	are located on control room backpanels	
	P628	and	631, and	which components do they control?	(1.0)

this word is misteading - would never push ADS

pushbottons under normal conditions - may have

confused some people.

(1.5)

6.4 va. (14) AUTO/OPEN control switches; SRVs "A" and "B" solenoids. = DAII 7 PDS valves (1.0)

b. If a low pressure ECCS pump is not operating (0.75); so that core will not be uncovered (0.75) (1.5)

Ref: WNP-2 System and Procedures, ADS, pg. 13 and 8, respectively.

6.5 With regard to the AC Electrical Distribution System:

·a.	Which lockout relay will be tripped upon a Transformer Differential Current (87TM)?	(0.5)
	List three (3) actions which will occur when the lockout relay in (a) is tripped?	(1.5)
	The loss of which $\frac{480 \text{V}}{\text{of}} \frac{\text{MC}}{\text{bus}}$ will deactivate both loops of $\frac{\text{shutdown}}{\text{cooling}}$?	(0.5)
detail-candidata.	What happens upon the loss of the normal and startup sources for SM-4?	(0.75)
detail-candidate		

6.5 -a. Unit lockout (86XU)

b. [any 3, 0.5 pts each]

Trips and locks-out all "N" breakers
Trips 4F circuit breaker (Generator Exciter Field Breaker)

Trips main turbine (20 AST)

De-energizes 86XIU

Starts oscillograph
Starts computer

C. MC-8-B-A

C. MC-8-B-A

MNP-2 System and Procedures; AC Distr.; pg. 15 and 16 for a, b, d; AOP 4.7.1.9, Loss of Power to SM-8, pg. 3 of 4 for c.

(0.5)

Thee they will also occur, same irt.

6.6 For the Reactor Core Isolation Cooling System, what position should the RCIC-V-8 and RCIC-V-63 keylocked control switches be placed in prior to resetting any isolation signal? Why?

14.

(1.5)

reset

6.6 CLOSED or STOP (0.5); otherwise (i.e. in OPEN), when isolation signal is received the valves would immediately open (0.5) which could cause extensive damage to system piping and components (0.5).

(1.5)

Ref: WNP-2, SOP 2.4.6, pg. 2 of 28.

6.7 If a selected control rod is in the selected 4 rod group and too many reed switch closures occur:

√a. What indication(s) would the operator observe? (1.0)

b. How could the control rod be moved through this position? (0.75)

A also withdraw Block, Rwnt Block (possibly - and also withdraw Block, Rwnt Block (possibly - and also withdraw Block, Rwnt Block (possibly - and and procedure).

implies 71

6.8 What design provisions are made to assure air flow through Standby Gas Treatment System filters. What is the basis for this?

(1.75)

6.8 Each SGT train has two full-capacity fans powered from separate emergency buses (0.75); to prevent filters from igniting on loss of air flow due to the decay heat generated by entrained radioactive materials (1.0)

(1.75)

Ref: WNP-2 Systems and Procedures, SGT pg. 24.

Would also likely get answer of cleaters on milet to been moisture from causing filter blockung, and demister. See stp pg 3

6.9 With regard to the Average Power Range Monitor System (APRM):

What three (3) things could happen if the back panel APRM Mode Switch was placed into the standby position during normal operation? (1.0)
 What is the AC power source for APRM Channel F? (0.5)
 Why is the Thermal Power Monitor necessary? (1.0)

6.9 a. APRM operates normally if bypassed (0.33); gives an INOP triptto warn operator if channel has not been bypassed (0.34). Will give 1/2 scram if channel not bypassed (0.33). or Diop Inhibit Switch degrees (1.0)

b. (Bus B supplied by) RPS MG set B. (0.5)

c. To avoid unnecessary scrams during power increase transients (due to flux leading thermal power). (1.0)

Ref: WNP-2 Systems and Procedures, APRM, pp. 26, 28 and 32-33, respectively.

(2.5)

7.0 Procedures - Normal, Abnormal, Emergency, and Radiological Control (25.0)

According to procedures for Emergency RPV Depressurization 7.1 (Contingency) (5.3.2): a. What is the primary system used to cause depressurization? (0.5)b. If the system in (a) is partially or totally unavailable, what is the next system to be used? (0.75)c. Under what conditions would systems other than those in a) and b) above be used and what are these systems?

7.1	a.	ADS	(0.5)
	b.	Other SRV's until 7 are open	(0.75)
	c.	If <3 SRV's are open (0.5); main condenser, main steam line drains, RCIC, head vents (2.0)	(2.5)
	Ref	: WNP-2 EOP 5.3.2, pp. 1, 1, and 2 of 8, respectively.	

7.2 What changes to the reactor power, MCPR, and MAPLHGR operating limits are required before one (1) recirculation loop operation is permitted? (2.25)

7.2 (0.75 each)

(2.25)

Reactor power: reduce it to <50% rated thermal power

MCPR: increase it by 0.01

MAPLHGR: reduce limit to 0.84 times the two loop op. limit.

Ref: WNP-2 AOP 4.2.1.10, pg. 2 of 3, and T.S. 3.4.1.1, pg. 3/4 4-1.

ANSWER SHOULD BE NONE. ALL ACTIONS
ARE REQUIRED AFFER THE PLANT IS IN
SINGLE LOOP

- 7.3 With regard to the operating procedure for 250V DC Distribution System (SOP 2.7.7):
 - a. What should the operator do and where would he do it, to tie the 250V DC battery B2-1 to the 250V DC distribution bus S2-1? (2.0)
 - b. When bus S2-1 is energized:
 - 1) What indication(s) does the operator have that no (0.75)
 - 2) What indication(s) does the operator have when a ground develops? (0.75)

- 7.3 a. 1) Verify open, on DP-S2-1, (0.34)
 (a) breaker S2-1/4B (0.33)
 (b) breaker S2-1/4C (0.33)
 (c) breaker S2-1/4D. (0.33)
 - 2) Close, on DP-S2-1, (0.34) breaker S2-1/3C and verify (0.33). (2.0)
 - b. 1) Two ground lamps on board "C" are lit. (0.75)
 - The lamp connected to the grounded polarity goes out and the appropriate bus ground annunciator comes on. (0.75)

Ref: WNP-2 SOP 2.7.7, pg. 2 of 5.

ANSWER SHOULD BE GENERALIZED TO SIMPLY SAY 1. STRIP BUS, ENERGIZE BUS, RELOAD BUS. THE PRESENT ANSWER REGUIRES MEMORIZATION OF OPERATING PROGREDURES, According to WNP-2 Annunciator Procedures, if the "OFF GAS VAULT RAD MONITOR DNSCL" annunciator alarmed, the operator should make a "verification" and a "check". Describe the verification and check to be made and at what location in the plant.

(2.0)

7.4 Verify: downscale condition of OG-RIS-11 (0.5); at P606 (0.5) (1.0)

Check: radiation level of OG-RI-11 (0.5); locally (0.5) (1.0)

Ref: WNP-2 Annunciator Procedures, 4. 02.A5-4.2.

THERE ARE MORE THAN 1400 ANNUNCIATOR PROCEOURES. Z POINTS IS TOO GREAT OF IMPORTANCE TO PLACE ON ONE OF THEM. PLEASE CONSIDER REDUCING POINT VALUE

- 7.5 According to the Operating Instructions for the Control Rod <u>Drive System (SOP 2.1.1)</u>:
 - a. During system startup, what should be the position (open or closed) for the following Hydraulic Control Unit (HCU) valves: (2.0)
 - 1) CRD-V-111 (Cartridge Valve Nitrogen Inlet)
 - CRD-V-107 (Accumulator Water Drain)
 CRD-V-102 (Withdraw Water Isolation)
 - 4) Withdraw Line "Dragon" valve.
 - b. During system startup, in what position should the operator place the charging water header vent valve (CRD-V-65) that is located between the charging water header isolation valve (CRD-V-34) and the HCU charging water inlet isolation valves (CRD-V-113/HCU)? Why? (1.5)

PROCEDURES TOTAL RECALL OF OPERATING PROCEDURES. ALSO THIS EVOLUTION IS ONLY FOR STARTUP AFTER COMPLETE DRAIN DOWN, AND DONE VERY SELDOM

7.5 a. (0.5 ea.)

(2.0)

- 1) Open
- 2) Closed
- 3) Open
- 4) Closed
- Dpen (0.5); to provide leak off (0.5) so that HCU accumulators will not pressurize due to valve leakage (0.5) (1.5)

Ref: WNP-2 SOP 2.1.1, pp. 4 and 6 of 41, respectively.

According to the procedures for Normal Shutdown To Cold Shutdown (G.O.P. 3.2.1), at what percent power (approximate) 7.6 should the following actions be performed?

(2.0)

- a. Transfer the 6900 volt switchgear from the normal auxiliary transformer to the startup transformer.
- Remove one feedwater pump, one condensate booster pump and one condensate pump from service.
- c. Verify operability of RWM and RSCS.
- d. Transfer recirculation pump to 15 Hz.
- e. Unload and shut down main turbine.

> PROCEDURE IS WRONG-TECH SPECS REQUIRES RWM-RSCS TO BE OPERABLE PRIOR TO BEDING DECREASING BEZOW 20% 7.6 (0.4 ea.) (2.0)<20% >15% <40% >35%

<20% >15%-

35%

<5%

Ref: WNP-2 GOP 3.2.1, pp. 4, 3, 4, 3 and 11, respectively.

According to the procedure AOP 4.7.4.1 for Loss of 7.7 Inverter-1(IN-1):

a. What are two (2) of the three annunciator alarms the operator should see? (1.0)b. What two (2) automatic actions will occur? (1.0)c. If voltage is not normal on US-PP, list the actions that should be taken and in their preferred sequence. (1.5)

a. Annunciator alarm (any 2, 0.5 ea.): (1.0)

1) "250 VDC Inverter ALT Source Loss"

2) "250 VDC Inverter ON Alt Source Loss"

3) "250 VDC Inverter TROUBLE Alt source Loss"

b. (0.5 ea.) (1.0)

Static switch transfers to ALT AC input (MC-7F)

2) DEH system will auto transfer to alternate AC.

c. (0.4 ea. action; 0.1 ea. sequence) (1.5)

1) Attempt to restore IN-1 to service, or

 Switch IN-1 to "Maintenance" position, or
 Shift US-PP to bypass source via "KIRK KEY INTERLOCK" (MC-7A).

Ref: WNP-2 AOP 4.7.4.1, pp. 1, 1-2, and 2, respectively.

- With regard to Accident Monitoring Instrumentation, according to Tech. Specs .:
 - Under what operational conditions (use number only) are the following instruments to be operable? (2.0)
 - 1) Post-accident Sampling Primary Coolant radiation monitor
 - 2) Standby Service Water Flow
 - 3) Neutron Flux IRM
 - 4) Safety/Relief Valve Position Indicators.
 - b. For the instruments in (a) above, what are the required minimum number of operable channels? (1.0)

- a. 1) 1, 2, 3 (0.68) 2) 1, 2 (0.44)

 - 3) 1, 2 (0.44) 4) 1, 2 (0.44)

(2.0)

b. (0.25 ea.)

(1.0)

- 2) 1/loop
- 3) 1
- 4) 1/valve

Ref: WNP-2, Tech. specs., pp. 3/4 3-71 and 72, 71 and 72, respectively.

QUESTION REQUIRES TOTAL RECALL DOUBTFUL ANYONE WILL GET RIGHT PLEASE RECONSIDER POINT VALUE.

7.9 According to the WNP-2 Health Physics Program:

- a. For <u>Emergency Exposure Guides</u>, <u>two</u> (2) emergency situations are given with their exposure guideline values. What are these situations and values? (1.0)
- b. An RWP is required when work is to be performed in an area that is posted for airborne radioactivity 5% of MPC (TRUE or FALSE). (0.5)

- 7.9 a. [situation (0.35), value (0.15) ea.] (1.0)

 - Life saving 75 rems whole body
 Protection of public health or property 25 rems whole body.
 - b. False (0.5)

Ref: WNP-2, Health Physics Program; 3.1.5 pg.3 and 3.1.8 and pg.2, respectively.

8.0 Administrative Procedures, Conditions, and Limitations (25.0)

8.1	a.	What are the two (2) LCOs with regard to leakages from unidentified sources?	(1.25)
	b.	What is the basis behind the unidentified leakage rates?	(0.75)

8.1 a. 1. 5 gpm total 2. 2 gpm increase within any 4-hr period. (0.5)

b. The crack associated with such leakage would not grow rapidly (would be less than the critical size for rapid propagation). (0.75)

Ref: WNP-2 Tech. Spec., pg. 3/4 4-9 and B 3/4 4-2, respectively.

- 8.2 During plant <u>shutdown</u>, the maintenance supervisor informs you that on routine checking he found the Division 1 250 volt battery B2-1 discharged, the reason unknown:
 - a. Do Tech. Specs. required action (YES or NO)? Explain. (1.5)
 - b. What three battery "parameters" are checked at least once every seven days to verify they meet Category A surveillance requirements?

Ince requirements?

(1.5)

Specific specific specific for "Constent of surveillances which they do not actively printicipate in. This question should be deleted or much flexibility allowed for in the candidates! Answer.

- 8.2 a. Yes, (0.5); with less than Div. 1 and/or Div. 2 above required battery or chargers operable, suspend core alterations, handling of irradiated fuel in sec. containment and operations with potential of draining vessel (1.0). (1.5)
 - b. (0.5) each:
 - Electrolyte level
 - Float voltage
 - Specific gravity

(1.5)

Ref: WNP-2 T/S, pg. 3/4 8-11 and 8-14 respectively.

ANSWER a" gives only the Action STATEMENT for the LCO. CREDIT should also be given for an explanation of why the candidate believes his answer to be as he indicated. If you wanted the action STATEMENT, it should have been asked for,

8.3 Which of the following occurrences require 1 hour reports to the NRC:

(2.0)

- a. reactor water level -50 inches
- b. reactor water level < -129 inches
- c. site boundary dose > 50 MR/hr whole body
- d. stuck open main steam relief valve

NOT REOD 1- PIR-

8.3 All of the 4 occurrences (since each requires a declaration of an emergency event and this is a category of reportable events).

Ref: CAF.

(2.0)

declaration of AN emergency may or may not occur depending upon the amount of time that each tem exists (ie, if a SRU can be shut outckly, why declare a UE immediately?).

8.4 With regard to the Fire Brigade:

a.	What is the minimum number of personnel required?	(0.5)
b.	Who are specifically excluded from the Fire Brigade?	(0.75)
c.	Where and when is the Fire Brigade to be maintained?	(0.75)

b. The Shift Supervisor, the STA and the 3 members of the minimum shift crew necessary for safe shutdown of the unit and any personnel required for other essential functions during a fire emergency. (0.75)

c. Onsite (0.375) at all times (0.375). (0.75) Ref: WNP-2 Tech. Spec., pg. 6-1. 8.5 According to Tech. Specs., in order for the Fire Suppression Water System to be considered operable, three (3) conditions must be met. State these conditions. (3.0)

8.5 a. At least two of the three OPERABLE fire suppression pumps pumping from the circulating water basin, or one dieseldriven pump pumping from the secondary water supply tank, with their discharge aligned to the fire suppression header.

(1.0)

b. Two separate fire water supplies, the recirculating water pump house inlet basin and the secondary water supply tank.

(1.0)

c. An OPERABLE flow path capable of taking suction from the circulating water pump house inlet basin and the secondary water supply tank and transferring the water through distribution piping with OPERABLE sectionalizing control or isolation valves to the yard hydrant curb valves, the last valve ahead of the water flow alarm device on each sprinkler or hose standpipe and the last valve ahead of the deluge valve on each deluge or spray system required to be OPERABLE.

(1.0)

Ref: WNP-2 T.S. pg. 3/4 7-18.

- 8.6 According to the Limitations stated in the Operating Procedures for the Reactor Core Isolation System (RCIC) (SOP 2.4.6):
 - a. What must you do to manually isolate RCIC when system initiation is not sealed in?

(0.75)

b. Under what condition(s) can the auto flow controller (RCIC-FIC-600) be removed from automatic?

(0.75)

8.6 a. Close the isolation valves using their respective control switches.

(0.75)

b. Only with permission of the Shift Supervisor.

(0.75)

Ref: WNP-2 SOP 2.4.6, pg. 2 and 3 of 28, respectively

0.3757 will be all

shoulth I

With regard to certain shift personnel and their functions: 8.7

a.	There must be two (2) licensed reactor operators in the Control Room at all times (TRUE or FALSE)?	(0.5)
b.	During new fuel handling operations, a licensed reactor operator must be on the refueling floor (TRUE or FALSE)?	(0.5)
c.	During what modes of operation shall the Shift Technical Advisor be on shift?	(0.5)
d.	If, while at power, the Shift Manager is incapacitated.	

what action(s) should be taken? (0.75)

8.7 a. False (0.5)b. False (0.5)c. Modes 1, 2 and 3. (0.5)d. The CRS or licensed SRO (other than STA) shall assume his duties and immediately advise the Operating Manager. (0.75)Ref: WNP-2 Admin. Prcc: 1.3.2, pp. 3 (for a and c) and 2 for (d); 6.2.3, pg. 2 for (b).

- According to Standing Order/Night Orders (Admin. Proced. 1.3.1): 8.8
 - a. A break occurs in a RCIC line. Would the following control room instruments provide valid indications (Yes or No)? If "NO", how could you verify the necessary information? (1.5)
 - 1) MS-LI 610
 - RHR-FI-603B
 - 3) SLC-LI-601
 - b. Following each refueling outage, independent verification of the operable status is required for what types of equipment?

(1.0)

of undustried instruments as referenced in 1111/31. The whole purpose of putting the appendix in The PILL UNS TO ALLOW IT TO be Referenced if Required! Instrument's are labeled to inter Line status.

depends on the nature of the accident.

- 8.8 a. 1) No (0.2); Use alternate instrument MS-LR-615 (0.3) 2) No (0.2); locally (0.3)

3) No (0.2); locally (0.3) (1.5)

b. Safety related (0.5) and fire protection equipment (0.5)(1.0)

Ref: WNP-2 Admin. Proc. 1.3.1, pp. 7 and 3, respectively.

8.9 According to Monthly Operational Bulletins:

a.	What would occur if RHR valves V-8, 9, 68 and RHR-27A were opened?	(1.0)
h	How did the follows on the obligation in the second	

- b. How did the failure, on two shifts, to check chart movement on wetwell level recorder CMS-LR/RR-4 contribute to loss of wetwell level? (1.0)
- c. Why is it important to ensure that <u>local</u> temperature indicators at the <u>nitrogen</u> supply shed and in the reactor building are monitored? (1.0)

- 8.9 a. The reactor vessel would be drained to the suppression pool. (1.0)
 - b. The recorder had been, in fact, inadvertently de-energized so that annunciator alarm switches activated by the recorder pen were also 0.0.S. (1.0)
 - c. No control room monitors exist. If nitrogen temperature gets too low, nitrogen flow onto a 30 in. dia. containment purge header and onto wetwell and drywell purge liner inside containment could cause failure through nitrogen embrittlement. (1.0)

Ref: WNP-2 Monthly OP Bull: January 1984, pg. 4; April-May, pg. 1; Feb-Mar, pg. 6, respectively.

This is AN unfair Question! Initial TRAINING does not necessarily incorporate more training into it. Without the benefit of Reading the more the chances of candidates getting the correct answer is minimal! Additionally, part a 4 c are more of a system oriented Question Than Admin, etc., and should not be part of Catagory 8.

8.10 With regard to the Emergency Plan Implementation Procedures, which of the four emergency classes would you place the following:

(2.0)

1) An ATWS

2) HCTL exceeded

 Volcanic ash fallout severe enough to warrant plant shutdown

4) Transport of a contaminated individual offsite

8.10 (0.5 ea.)

(2.0)

1) Alert

2) Site Area Emergency

3) Alert

4) Unusual Event

Ref: WNP-2 EPIP: 13.1.1, pp. 6, 20, 7 of 21, respectively.

MEMORITATION OF EPIP 13.1.1 is NOT feasible. While

The majority of the symptomatic conditions which call

for event classification are well known, the situational

lased events are much more unque. I cannot imagine

any exercise operator declaring an emergency event

without reference to EBP's or EPIP's for

guidance.

8.11 With regard to Control Of Plant Operating Keys:

- a. What is the limitation(s) with regard to issuing of bypass and interlock keys not required for normal (0.75) operation?
- b. Besides the bypass and interlock keys, there are two (2) other kinds of keys: (1.0)
 - What are they?
 Where are they each stored?
 Who is responsible for them?

- 8.11 a. Issued to requesting party only with permission of Shift .
 Manager/CRS. (0.75)
 - b. (0.17 each for key type, location, responsible person.) (1.0)
 - Control room panel keys key cabinet in CR -Shift Manager/CRS.
 - Miscellaneous keys key cabinet in Radwaste CR Shift Support Manager
 Superuisor

Ref: WNP-2, admin. Proc. 1.3.23, pp. 1 and 2 of 21, respectively.

Foodty Review Copy

Reviewed by

Reviewed by

Edwin L. Wright

EDWight

Facility: WNP-2
Reactor Type: BWR-5
Date Administered: 11/6/84
Examiner: I. S. Levy
Candidate:

INSTRUCTIONS TO CANDIDATE:

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

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

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

Candidate's Signature

Questions and Answers to WNP-2 RO Exam - 11/6/84 EZW-th

1.0 Principles of Nuclear Power Plant Operation, Thermodynamics, Heat Transfer and Fluid Flow (25.0)

1.1 a of reactivity required to go critical, which determines ECP (0.75). [The higher the initial count rate, the higher the count rate when criticality is reached.] (1.25)

Ref: WNP-2 Reactor Theory, pg. 29 and 43.

b.
$$P = Po e^{(t/T)}$$

 $T = 40 / (ln2) = 57.71 sec^{-1}$
 $t = 57.71 (ln(P/Po)) = 212.88 sec$ (1.0)

Ref: WNP-2 Reactor Theory, pg. 61.

· Consider giving partial credit on b. if condidate used period of 40 sec since the question asks for the most part the condidate of emastrate the ability to manipulate the equation Paraely.

1.2 With regard to some aspects of Fission Product Poisons:

a. Of the two fission product poisons Xe and Sm, give two (2) reasons why xenon is more troublesome. (1.5)

b. What is the mechanism(s) for removal of Samarium-149 once it is produced in the core? (1.0)

a. (1) Because of its exceptionally large thermal neutron absorption cross-section (0.75); (2) its concentration varies with reactor power level and/or time (0.75) (2) he produced as result of rel. large frontion of fissions (1.5)b. Sm-149 is removed only by burnout (1.0)

Ref: WNP-2 Reactor Theory, pp. 83 and 87, respectively.

1.3

When control rod density in the core decreases at higher burnups (from pulling rods) the void coefficient of reactivity becomes more or less (choose one) negative? Why?

(1.5)

1.3 Less (0.5). Since local steam voids cause an increase in thermal diffusion length (0.5), control rods, which absorb thermal neutrons, make the steam void reactivity coefficient more negative (0.5) [Therefore, reduced control rod density causes the void coefficient to be less negative.]

(1.5)

Ref: WNP-2 Reactor Theory, pp. 98-99.

Resident 1.4

The effective decay constant for up power transients will be higher or lower (choose one) compared to its value for down power transients. Give the reason for your answer.

(1.5)

1.4 Higher (0.5). For up power transients the short lived precursors are dominant due to the addition of power (0.5), while for down power transients the long lived precursors dominate the decay constant (0.5)

(1.5)

Ref: WNP-2 Reactor Theory, pg. 54.



1.5 Following a scram from high power, answer the following:

who	a.	What are the most reactive regions of the core? Why are these regions more reactive?	(1.0)
My a	b.	Why are these regions more reactive?	(1.25)
	c.	What problem does this cause for the operator during a subsequent start up. Why?	(1.25)

1.5 a. Near the edges and at the top and extreme bottom

(1.0)

b. Xe concentrates, during power operation, where power is highest, i.e., in the center and near the bottom of the core (0.75), where it acts as a poison, adding negative reactivity (0.50)

(1.25)

c. Operator must be extremely cautious while pulling edge and top rods (0.5) since normally low worth rods now have excessively high incremental worths (0.75)

(1.25)
Ref: WNP-2 Lesson Plan, Figure 4-12.

1.6 Give four (4) inputs or outputs for a reactor heat balance, stating whether it is an input or output and a brief description as to why it is.

(3.0)

1.6 (any 4 @ 0.75 each)

(3.0)

- a. Feedwater flow heat input (0.25) going into the vessel (or system) with positive enthalpy (0.5).
- b. Steam flow heat output (0.25) due to steam removing energy from the core (0.5).
- c. Recirc pump heat input (0.25) due to energy added to the fluid in the core (or system) by the pumps (0.5)
- d. CRD flow <u>heat input</u> (0.25) due to fluid flowing into the core (or system) with a positive enthalpy (0.5).
- e. Rx core thermal energy heat input (0.25) due to being primary source of heat input (0.5).
- f. any other reasonable answer such as RWCU inputs/outputs, etc.

Ref: MTC; Thermo/HT/FF (3/83), pp. 8-50. ambiant losses

1.7 Following initial criticality (MSIVs closed, moderator T > 212°F), a constant positive period is established.

Briefly explain what happens over the next several hours to pressure, temperature and power if no rod movement occurs. (1.5)

1.7 Power initially increases but levels off due to negative reactivity insertion resulting from increasing moderator temperature (0.5). Pressure and temperature initially increase but level off when power levels off then reduces due to ambient losses (0.5). The reduced T causes the cycle to start again so that long term power, pressure and temperature will oscillate around point of adding heat (0.5).

(1.5)

Ref: Standard Reactor Theory.

1.8 What are two (2) reasons a centrifugal pump should be started with the discharge piping filled and the discharge valve shut? (1.0)

1.8 Water hammer and excessive starting current. (1.0)

Ref: Morris T.C.; Thermo/HT/Fluid Flow (3/83), pg. 7-123.

- 1.9 a. Assume the reactor is at 100% power and flow. Explain what happens to core flow, and why, for a reduction in power by driving rods in. (Recirculation pump speed remains constant.) (1.25)
 - b. At low power conditions prior to void generation, an increase in reactor power by control rod withdrawal will (increase, decrease, not change) flow through the core.

 Choose the correct answer and explain your choice. (1.5)

- 1.9 a. Core flow would increase (0.5) due to a reduction in two phase flow condition (and, therefore, in the core less resistance to flow) (0.75). (1.25)
 - b. Increase (0.5). Flow resistance in the channels drops due to decreased liquid viscosity with temperature (0.5); and greater density differences between warm channels and cool downcomer will increase flow due to increased thermal driving load causing greater natural circulation (0.5) (1.5)

Ref: Morris T.C.; Thermo/HT/Fluid Flow (3/83), pg. 9-51.

- 1.10 There are several characteristic transients that would be limiting because of MCPR.
 - a. List any two (2) of these transients. (0.75)
 - b. Assuming for each of the transients in (a) they occurred at 100% power, EOC and full rod out conditions, give:
 - the most important reactivity ccoefficient involved. (0.5)
 - 2. What occurred in the reactor and why it occurred to affect this coefficient. (0.5)

- 1.10 Any 2 of following. pts: a) 0.375 each; b) (1) 0.25 each; (2) 0.25 each (1.75)
 - Generator load reject w/o bypass; void coefficient, void collapse from pressure increase
 - Turbine trip w/o bypass; void coefficient, void collapse from pressure increase
 - Loss of feedwater heating, void coefficient, void collapse from subcooling
 - Inadvertent start of HPCS pump; void coefficient, void collapse from subcooling
 - Feedwater controlling failure high; void coefficient, void collapse from subcooling

Ref: Morris T.C.; Thermo/HT/Fluid Flow (3/85), pg. 9-94 through 9-96.

1.11 Given:

Rx pressure at time T = 675.3 psig
Rx pressure at time T + 1 hr = 215.3 psig

- a. What is the Rx cool down rate for this hour? Show all calculations. (0.75)
- b. Is this rate acceptable at your plant? (0.5)

- 1.11 a. (Because the reactor operates at saturated conditions the temperature for time T and T + 1 hr can be found using the steam tables.)
 - 1) Saturation temperature for 690 psia is approximately 502°F.
 Saturation temperature for 230 psia is approximately 394°F. (0.375)
 - 2) Cool down rate = $(502^{\circ}F 394^{\circ}F)/1$ hr. Cool down rate = $108^{\circ}F/1$ hr. (0.375)
 - b. No. (The cool down rate limit is 100°F per hour.) (0.5)

Ref: Steam Tables and WNP-2 Tech. Specs.

1.12 Answer TRUE or FALSE for each of the following:

- a. As water flows around a bend in a pipe, the velocity of the water is uniform throughout the diameter of the pipe. (0.5)
- b. The pressure in a static fluid always <u>decreases</u> with <u>increasing</u> elevation of the measurement. (0.5)

1.12 a. False (0.5)

b. True (0.5)

Ref: General Fluid Dynamics Text.

1.13 Will an increase in the following factors (taken separately)
increase, decrease, or not change differential rod worth? (1.5)

a. thermal diffusion lengthb. neutron flux at the rod

c. core average neutron flux

1.13 a. increase

b. increase - a soming no change in core aways on (0.5)

c. decrease - assuring no change in local flux. Usually an increase in (0.5)

core average flux would canco some change in local

Ref: WNP-2 Reactor Theory, pg. 80.

flux - it may be that this particulated in temperated so that there is so change in DKW; No change should be acceptable.

$$\alpha_D = -1 \times 10^{-5} \frac{\Delta K}{K}$$
°F

$$\alpha_v = -1 \times 10^{-3} \frac{\Delta K/Z}{K}$$
 voids

$$\alpha_{M} = -4.5 \times 10^{-4} \frac{\Delta K / Z^*F}{K}$$

$$I(t) = Io e^{-\lambda t}$$

$$T\frac{1}{2} = \ln(2)/\lambda$$

$$\Delta \rho = f \frac{L_{\rho V}^2}{D_{2g_c}}$$

$$\rho = \frac{k(eff) - 1}{K(eff)}$$

$$M = 1/(1-k)$$

$$N(t) = No e^{-\lambda T}$$

$$n = v/(1 + d)$$

$$P = I + v/(3.7 \times 10^{10})$$

$$\tau = \overline{2}/\rho + (\beta-\rho)/\lambda\rho$$

$$S = xS_g + (1-x) S_f$$

17.58 watts = I BTU/min

lpsi = 6.895 Pa

lpsi = 2.036 = Hg (@ OC) lpsi = 27.68 = H²O (@ 4C)

-

	Abs desire		able 1.		o steam	Enthaigy	rature Ta		Entropy		
femp fahr t	Abs Press. Lo per Sq in	Sat Liquid	Evap	Sat. Vapor Vg	Sat. Liquid	Evap	Sat. Vapor	Sat Liquid Si	Evan Sig	Sat Vapor S g	Temp Fahr
12 6" 14 8 36 8 38 8	0 08859 0 09600 0 10J95 0 11249	0 016022 0 016021 0 016020 0 016019	3304 7 3061 9 2839 0 2634 1	1304 7 3061 9 2839 0 2634 2	-00179 1996 4008 6018	1075 5 1074 4 1073 2 1072 1	1075 5 1076 4 1077 2 1078 1	0 0000 0 0041 0 0081 0 0122	2 1873 2 1762 2 1651 2 1541	2 1873 2 1807 2 1732 2 1663	22 d 24 d 26 d 28 d
44.8 47.0 64.6 26.0	61:163 013143 014192 015314 016514	0 016019 0 016019 0 016019 0 016020 0 016021	2445 8 2272 4 2112 8 1965 7 1830 0	2445.8 27.72.4 1112.8 1965.7 1830.0	3 027 10 035 12 041 14 047 16 051	1071 0 1069 8 1068 7 1067 6 1066 4	1079 0 1079 9 1050 7 1051 6 1082 5	0 0162 0 0202 0 0247 0 0282 0 0321	2 1325 2 1325 2 1217 2 1111 2 1006	2 1594 2 1527 2 1459 2 1393 2 1327	42 6 42 6 44 6 44 6
58.8 52.8 54.8 56.0 58.8	0 177% 0 19155 0 20625 0 22151 0 23843	0 016023 0 016024 0 016026 0 016028 0 016031	1704 8 1589 2 1482 4 1383 6 1292 2	1704 8 1589 2 1482 4 1383 6 1292 2	18 054 20 057 27 058 24 059 26 060	1065.3 1064.2 1063.1 1061.9 1060.8	1084 2 1085 1 1086 0 1086 9	0 0361 0 0400 0 0439 0 0478 0 0516	2 0901 2 0798 2 0695 2 0593 2 0491	2 1257 2 11 1 2 10 1 2 10 10	10 t 52 t 54 t 36 t 38 t
60 0 62 0 64 0 56 0 64.0	0 25611 0 27294 0 29497 0 31626 0 33889	0 016033 0 016036 0 016039 0 016043 0 015046	1207 6 1129 2 1056 5 989 0 928 5	1207 6 1129 2 1056 5 989 1 926 5	28 060 30 059 32 058 34 056 36 054	1059 7 1054 5 1057 4 1056 3 1055 2	1087 7 1083 6 1089 5 1090 4 1091 2	0 0555 0 0593 0 0532 0 0670 0 0708	2 0391 2 0291 2 0192 2 0094 1 9996	2 094-, 2 0885 2 082- 2 076-3 2 0704	62 (62 (64 (66 (68 (
78.8 72.0 14.0 78.0 78.0	0 36292 0 38514 0 41550 0 44420 0 47461	0 018050 0 015054 0 015058 0 015063 0 016067	868 3 814 3 764 1 717 4 672 8	968 4 814 3 764 1 717 4 673 9	38 052 40 019 42 046 44 043 46 040	1054 0 1052 9 1051 8 1050 7 1049 5	1092 L 1093 0 1093 8 1094 7 1095 6	0 0745 0 0783 0 0821 0 0858 0 0895	1 9900 1 9804 1 9708 1 9614 1 9520	2 0645 2 0587 2 0529 2 0472 2 0415	70 1 72 1 76 1 76 1
86.8 67.6 64.0 36.0 88.0	0 50683 3 54093 0 57702 0 61518 0 65551	0 016077 0 016077 0 015082 0 016087 0 016093	623 3 595 5 560 3 527 5 496 8	633 3 595 5 560 3 527 5 496 8	48 037 50 033 52 029 54 026 56 022	1048 4 1047 3 1046 1 1045 0 1043 9	1096 4 1097 3 1098 2 1099 0 1099 9	0 0932 0 0969 0 1005 0 1043 0 1079	1 9426 1 9334 1 9242 1 9151 1 9060	2 0259 2 0303 2 0248 2 0193 2 01 79	17 84 88 88
12 0 12 0 14 0 16 0 18 0	0 69813 0 74313 0 79062 0 84072 0 89356	0 016099 0 016105 0 016111 0 016117 0 016123	468 441 3 416] 392 8 370 9	468 1 441 3 416 3 392 9 370.9	58 01 8 60 01 4 52 01 0 64 006 64 003	1041 6 1040 5 1039 3 1038 2	1100 8 1101 6 1102 5 1103 3 1104 2	01115 01152 01138 01224 0.1260	1 8970 1 5881 1 8792 1 8704 1 3617	2 0086 2 0033 2 9940 1 9428 1 9876	90 97 94 96 96
196 0	0 94924 1 00789 1 06965 1 1347 1 2030	0 016130 0 016137 0 016144 0 016151 0 016158	350 4 331 1 313 1 296 16 280 28	350 4 331 1 313 1 296 18 280 30	67 999 69 995 71 992 73 99 75 98	1037 1 1035 9 1034 8 1033 6 1032 5	1105 I 1105 9 1106 8 1107 6 1108 5	0 1295 0 1331 0 1366 0 1402 0 1437	8444	1 9575 1 9775 1 9775 1 9775 1 9475 1 9475	1 00 1 02 1 04 1 04 1 08
110 0 112 0 114 0 118 0 118 0	1 2750 1 3505 1 4299 1 5133 1 6009	0 015165 0 016173 0 016180 0 016188 0 016196	265 37 251 37 238 21 225 84 214 20	265 19 251 18 238 22 225 85 214 21	77 98 79 98 91 97 83 97 85 97	1031 4 1030 2 1029 1 1027 9 1026 8	1109 3 1110 2 1111 0 1111 9 1112 7	0 1472 0 1507 0 1542 0 1577 0 1611	1 8105	1 9577 1 9528 1 9480 1 9433 1 9386	118 217 114
178.8 177.0 174.6 175.8 178.8	1 6927 1 /891 1 8901 1 9959 2 1068	0 016204 0 016213 0 016221 0 016229 0 016238	203 25 192 94 183 23 174 08 165 45	203 26 192 95 183 24 174 09 165 47	87 97 59 96 91 96 93 96 95 96	1025 6 1024 5 1023 3 1022 2 1021 0	11136 11144 11153 11161 11170	0 646 0 680 0 749 0 783	1.7693 1.7613 1.7523 1.7453 1.7374	1 9339 1 9291 1 9247 1 1202 1 9157	178 177 174 178 178
138 8 137 8 134 8 138 8 138 8	2 7230 2 3445 2 4717 2 6047 2 7438	0 016247 0 016256 0 016265 0 016274 0 016284	157 32 149 64 142 40 135 55 129 09	157 33 149 66 147 41 135 57 129 11	97 % 99 95 101 95 103 95 105 95	1019 8 1018 7 1017 5 1016 4 1015 2	1117 8 1118 6 1119 5 1120 3 1121.1	0 1817 0 1851 0 1884 0 1918 0 1951	1,7795 1,7217 1,7140 1,7063 1,6986	1 9112 1 9268 1 9024 1 8980 1 8337	120 122 124 128 128
140 0	2 8892 3 0411 3 1997 3 3653 3 5381	0 016293 0 016303 0 016312 0 016322 0 016332	172 98 117 21 111 74 106 58 101 68	123 00 117 22 111 76 106 59 101 70	107 95 109 95 111 95 113 95 115 95	1014 0 1012 9 1011 7 1010 5 1009 3	1127 0 1127 8 1127 6 1124 5 1125 3	0 1985 0 2018 0 2051 0 2054 0 2117	1 6910 1 6534 1 6759 1 5684 1 6610	1 8895 1 8552 1 8810 1 8769 1 8777	148 147 144 145
198 8 152 8 154 8 156 8 158 8	3 71 54 - 3 9065 4 1025 4 3068 4 5197	0016343 0016353 0016363 0016364	97 05 92 66 88 50 84 56 86 82	9/07 92 68 88 52 84 37 80 83	117 95 119 95 121 95 123 95 125 96	1008 2 1007 0 1005 8 1004 6 1003 4	1126 9 1127 7 1128 6 1129 4	0 2150 0 2183 0 2216 0 2218 0 2218	1 6536 1 6463 1 6390 1 6318 1 6245	1 6586 1 3546 1 8506 1 8566 1 8526	150 152 154 156 156
160 0 167 8 164 0 166 0	4 /414 4 9722 5 2124 5 4423 5 /223	0 016395 0 016406 0 016417 0 016428 0 016440	77 27 73 90 70 70 67 67 64 78	77 29 73 92 70 72 67 68 64 80	127 96 129 96 131 96 133 97 135 97	1002 2 1001 0 999 8 998 6 997 4	1130 Z 1131 0 1131 8 1132 6 1133 4		1 6174 1 6103 1 6032 1 5961 1 3892	1 8487 1 8448 1 8409 1 8371 1 8333	160 to 162 to 164 to 16
78 6 172 8 174 6 178 8	5 9976 6 2736 6 5656 6 6090 7 , 240	0016451 0016474 0016474 0016498	62 04 59 43 59 95 54 59 52 35	62 06 59 45 56 97 54 51 52 36	137 97 139 98 141 98 143 99 145 99	996 2 995 0 943 8 992 6 991 4	1134 2 1135 0 1135 8 1136 6 1137 4	0 2473 0 2505 0 2537 0 2568 0 2600	1 5822 1 5753 1 5684 1 5616 1 5548	1 8258 1 8258 1 8221	178 s 172 s 174 s 174 s

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Table 1	Sanirated	Steam.	Tamparatura	Table_C	

t	Abs Press		ecific Vo	lume	***	Enthalo			Entroo		Temp
fans fans	Sq in	Sat. Liquid	Evap	Sat Vapor Va	Liquid	Evap	Vapor n g	Liquid	t Evap	VACOI	Fanr
100 0 102 0 104 0 106 0	75110 7850 8.203 8.568 8.947	0016510 0016522 0016534 0016547 0016559	50 21 48 172 36 232 44 383 42 621	50 22 48 1 99 46 2 49 44 400 42 638	148 00 150 01 152 01 154 02 156 03	990 2 989 0 987 5 986 5 985 3	1138 2 1139 0 1139 8 1140 5 1141 3	0 2631 0 2652 0 2694 0 2725 0 2756	1 5480 1 5413 1 5346 1 5279 1 5213	1 8111 1 8075 1 8040 1 8004 1 7969	188 8 182 8 184 8 186 8 186 8
198 8 197 8 198 8 198 8	9 340 9 727 10 168 10 505 11 058	0 016577 0 016585 0 016598 0 015611 0 016628	40 941 39 337 37 808 36 348 34 954	40 997 79 354 37 824 36 364 34 970	158 04 160 05 162 05 164 06 166 08	984 987 3 981 6 980 4 979	1142 1 1142 9 1143 7 1144 4 1145 2	0 2 /87 0 2 18 0 2 18 0 2 10 0 2 10	1 5148 1 5082 1 5017 1 4952 1 4868	1 7934 1 7900 1 7865 1 7831 1 7778	196 0 197 0 194 0 198 6 198 6
200 0 264 0 206 0 212 0 216 0	11 526 12 512 13 568 14 696 15 901	0 015637 0 015634 0 016691 0 016719 0 016747	33.627 31 135 28 862 26 782 24 878	13 6 79 31 151 28 8 78 26 799 24 894	168 09 172 11 176 14 180 17 184 20	977 9 975 4 977 8 970 3 967 8	1146 0 1147 5 1149 0 1150 5 1152 0	0 2940 0 1001 0 1061 0 3121 0 3181	1 4697 1 4571 1 4447 1 4323	17752 17498 17632 17568 17505	200 0 204 0 208 0 217 0 218 0
270 0 224 0 228 0 221 0 231 0	17 188 18 556 20 015 21 567 23 216	0.016775 0.016805 0.016834 0.016864 0.016895	23 131 21 529 20 056 18 701 17 454	23 148 21 545 20 073 18 718 17 471	188 23 192 27 196 31 200 35- 204 40	965 2 962 6 960 0 957 4 954 8	1151 4 1154 9 1156 J 1157 8 1159 2	0 3241 2 3300 3 3159 0 3476	1 4701 1 4081 1 3961 1 3847 1 3775	1 7342 1 7380 1 7320 1 7350 1 7350	278 0 274 0 276 0 276 0 272 0 276 0
248.6 248.6 248.6 252.6 256.8	24 958 26 526 28 796 30 583 33 091	0.016928 0.016958 0.016990 0.017022 0.017025	16 304 15 243 14 264 13 358 12 520	16 321 15 260 14 281 13 375 12 538	208 45 212 50 216 56 220 62 224 69	952 949 5 946 8 944 941 4	1160 6 1162 0 1163 4 1164 7 1166 1	0 3533 0 1591 0 3649 0 3706 0 3753	1 3509 1 3494 1 3379 1 3266 1 3154	17142 17085 17028 16972 16917	248 8 244 0 248 6 252 0 252 0
268 6 264 6 268 8 272 6 272 6	35 427 37 894 40 500 43 249 46 147	0 017089 0 017123 0 017157 0 017153 0 017228	11 745 11 025 10 358 9 738 9 162	11 762 11 042 10 375 9 755 9 180	228 75 232 83 236 91 240 99 245 08	938 6 935 9 933 1 930 3 927 5	1167 4 1168 7 1170 0 1171 3 1172 5	0 3819 0 3876 0 3932 0 3987 0 4943	1 3043 1 2933 1 2823 1 2715 1 2607	1 5852 1 6808 1 6755 1 6702 1 6650	264 0 264 0 268 0 277 0 278 0
798 6 784 8 788 6 792 6 792 6	49 200 52 414 55 795 59 350 63 086	0 017764 0 01730 0 01734 0 01738 0 01741	8 627 8 1290 7 6634 7 2301 %.8259	\$ 644 8.1453 7.6807 7.2475 6.8433	249 17 253 3 257 4 261 5 265 6	924 6 921 7 918 8 915 9 913 0	1173 8 1175 0 1176 2 1177 4 1178 6	0 4098 0 4154 0 408 0 4263 0 4317	1 2501 1 2395 1 2290 1 2186 1 2082	1 6599 1 65-3 1 6434 1 6-49 1 6400	290 0 284 0 288 0 292 0 295 0
200 8 194 8 198 9 112 8 118 8	67 005 71 119 75 433 79 953 84 688	001753	6 4483 6 0955 5 7655 5 4566 5 1673	6 4658 6 1 30 5 7810 5 4/42 5 1849	269 7 273 5 278 Q 282 L 296 3	907 0 904 0 901 0	1179 7 1150 9 1182 0 1183 1	04533	1 1877 1 1.75 1 1674	6351 6303 6356 6209	100 8 304 0 108 0 317 9
178 8 174 8 178 6 132 8 136 8	89 64 3 94 826 100 245 105 907 111 820	0 01/70 0 01/74 0 01/79	4 8961 4 6418 4 4030 4 1/88 1 9681	4 9138 4 6595 4 4208 4 1346 3 9859	290 4 274 6 298 7 302 9 307 1	894 8 891 6 888 5 385 J	1185 2 1186 2 1187 2 1188 2	0 4540 0 469? 0 4745 0 4798	11277 11378 11280 11183	6162 6116 6071 6075 5981	276 6 274 6 274 6 128 6 137 0
44 6 44 6 152 8 152 8	117 992 124 430 131 142 138 138 145 424	001797	7699 35834 14078 17473 10863	3 7878 3 601 3 3 4256 3 2503 3 1044	311 3 315 5 319 7 323 9 328 1	878 8 875 5 872 2 868 9	190 I 191 0 191 I 192 7	0 4902 0 4954 0 5006 0 5058	1 0990 1 1 0894 1 1 0799 1	5936 5892 5549 5606 5763 5721	348 0 348 0 348 0 348 0 352 0
50 0 54 0 72 0 72.0	153 010 160 903 169 113 177 648 186 517	0 01816 2 0 01821 2 0 01826 2	9292 8002 6691 5451 4279	2 7573 2 8184 2 6873 2 5633 2 4462	332 3 336 5 340 8 345 0 349 3	858 6 855 1 1 851 6 1	194 4 195 2 195 9 196 7 197 4	05161 05212 05263 05314	0517 1 3424 1 0332 1 0240 1	5678 5637 5595 5554	256 6 260 6 264 6 288 6 377 0
N 0 64 0 10 0 17 1 18 0	195 729 205 294 215 270 225 516 236 193	001847 2 001847 2 001853 2	3170 2120 11.6 0184 9291	2 3353 2 2304 2 1311 2 0369 1 9477	353 6 357 9 362 2 366 5 370 8	844 5 1 840 8 1 837 2 1 633 4 1	198 0 198 7 199 1 199 9 200 4	0 5416 1 0 5456 0 0 545 0 0 5567 0	0057 1 9966 1 9876 1 9786 1	5513 5473 5412 5392 5352	376 0 184 0 184 0 189 0 187 0
171	247 759 258 725 270 600 282 894 295 617	0018/5 1	8448 7540 6877 6152 5463	1 96 30 1 78 27 1 7064 1 63 40 1 56 51	375 1 379 4 383 8 388 1 392 5	825 9 1 827 0 1 818 2 1 814 2 1	201 0 201 5 201 9 202 4 202 8	05667 0 05/1/ 0 05/46 0 05816 0	9507 9518 44,9 9141	5313 5274 5134 5195 5157 5118	499 0 499 0 494 8 494 0 417 0
	308 780 322 391 336 463 351 00 366 03	0 01900 1 0 01906 1	184 1184 3191 0266 14867	1 4997 1 4374 1 3782 321 '9 26406	376 9 401 3 405 7 410 1 414 6	806 2 1 802 2 1 798 0 1 793 9 1	703 1 703 5 703 7 704 0 704 2	0 5915 0 0 5764 0 0 6014 0 0 6016 0	4165 1 40.11 1 5990 1 9903 1	9080 9047 9064 1966	416 8 470 8 471 0 476 8 437 0
2	381 54 397 56 414 09 411 14 448 73	001940 11 001940 11	4874 0212 5764	216A7 16806 12152 07711 03477		781 L L L L L L L L L L L L L L L L L L L	704 4 704 6 704 7 704 8 704 8	0 6161 0 0 6210 0 0 6259 0 0 5308 0	8729 8643 8557	1990 1853 1815	436 8 440 0 444 0 418 0 457 0

Table 1 Saturated Steam: Temperature Table-Continued

	405 2-455		ecitic Vol	ume		Enthaig	w		Entrag		
Fahr 1	Sq in	Fidniq	Evap	Vagor *e	Liquid	Evan	Vacor N,	L-quit	1 Ev40	Yagar	f - mg
450 0 464 0 156 0 472 0 476 0	466 87 485 56 504 43 574 67 545 11	0019'6	0 97463 0 93588 0 89885 0 86345 0 82958	0 99424 0 95557 0 91862 0 88329 0 84950	441 5 446 1 450 7 455 2 459 9	753 2 758 6 754 0 749 3 744 5	1204 8 1204 / 1204 6 1204 5 1204 3	0 6405 0 6454 0 6502 0.6551 0 6599	08.11 08.27 08042 07956	1 4704 1 4667 1 4529 1 4592 1 4595	468 8 464 5 462 6 477 5 476 8
186 6 181 6 186 6 197 8	566 15 587 81 610 10 613 03 656 61	0 02009 0 02017 0 02026	0.79716 0.76613 0.73641 0.70794 0.68065	0.81717 0.7%672 0.75658 0.72820 0.70100	469 1 473 8 475 5 483 2	739 6 734 7 729 7 724 6 719 5	1203 8 1203 5 1203 1 1202 7	0 6648 0 6696 0 6745 0 6793	0 7571 0 7785 0 7700 0 7614 0 7528	1 4518 1 4481 1 4407 1 4370	494 8 464 8 463 8 492 8 492 8
100 0 164 0 168 8 117 0	680 86 705 78 731 40 757 72 764 76	0 02053 0 02062 0 02072	0 65448 0 62938 0 60530 0 58218 0 55997	0 67492 0 64991 0 62592 0 60289 0 58079	487 9 492 7 497 5 502 3 507 1	714 3 709 0 703 7 598 2 692 7	1202 2 1201 7 1201 1 1200 5 1199.8	0 6890 0 69 19 0 6987 0 7036 0 7085	0 7227 0 7357 0 7271 0 7155 0 7299	1 4733 1 4296 1 4258 1 4221 1 4183	508 8 504 8 588 0 51 2 8 51 8
128 8 124 8 128 8 132 8 133 8	812 53 841 04 870 31 900 34 931 17	9 02102 9 02112 9 02123	0 53864 0 51814 0 49843 0 47947 0 46123	0 55956 0 57916 0 51955 0 50070 0 48257	5120 5169 5218 5268 5317	641 1 675 5 669 6 663 6	1199 0 1198 2 1197 3 1196 4 1195 4	9 7133 9 7182 9 7231 9 7280 9 7329	0 7013 0 6925 0 6839 0 6752 0 6665	1 4145 1 4108 1 4070 1 4032 1 3993	528 8 524 8 528 8 537 8 538 8
146 8 144 6 144 6 157 8 156 6	962 79 995 22 1028 49 1062 59 1097 55	0 02157	0 44367 0 42577 0 41048 0 19479 0 3 7956	0 46513 0 34834 0 41217 0 41660 0 40160	536 8 541 8 546 9 552 0 557 2	657 5 651 3 645 0 638 5 632 0	1194 3 1193 1 1191 9 1190 6 1189 2	0 7378 0 7427 0 7476 0 7525 0 7575	0 6577 0 6489 0 5400 0 6311 0 6222	1 3954 1 3915 1 3876 1 3837 1 3797	544 0 544 0 548 2 552 8 556 8
568 8 568 9 578 8	11 23 79 1170 10 1207 72 1246 26 1285 74	0 02221 0 02235 0 02249	0 36507 0 35039 0 33741 0 32429 0 31162	0 38714 0 37320 0 35975 0 34678 0 33426	562 4 567 6 577 9 578 3 583 7	625 3 618 5 611 5 604 5 597 2	1187 7 1196 1 1184 5 1182 7 1180 9	0 7625 0 7674 0 7725 0 7775 0 7825	0 6132 0 6041 0 5950 0 5859 0 5766	1 3757 1 3716 1 3675 1 3634 1 3592	564 0 564 0 564 0 572 0 578 8
184 C 184 C 182 B 192 B	1376 17 1257 7 1410 0 1453 3 1497 8	0 02211	0 29937 0 29753 0 27608 0 25499 0 25425	0 32216 0 31048 0 29919 0 28827 0 27770	589 1 594 6 600 1 605 7 611 4	589 9 582 4 574 7 566 8 558 8	1179 0 1176 9 1174 8 1172 6 1170 2	0.7875 0.7927 0.7978 0.8030 0.8082	0.5673 0.5580 0.5585 0.5390 0.5293	1 3550 1 2507 1 3464 1 3470 1 3375	580 0 564 0 568 5 597 8 556 8
00 0 04 0 08 0 17 0 16 6	1543 2 1589 7 1637 3 1686 1 1735 9	0 02382 0 0 02402 0 0 02422 0	24384 223374 22394 221642 120516	0 26747 0 25757 0 24796 0 23965 0 22960	6171 6229 628 F 634 8 640 8	550 6 542 2 533 6 524 7 515 6	1167 7 1165 1 1162 4 1159 5 1156 4	0 8134 0 8137 0 82-0 0 82-4 0 8348	05196 05097 04997 04996 04794	1330 13254 13235 13130	500 0 504 0 608 0 617 0
78 0 24 0 78 0 12 8 14 8	1786 9 1239 0 1892 4 1947 0 2002 8	0 02489 0 0 07514 0 0 02539 0	19515 18737 17880 17044 16226	0 22081 0 21225 0 20394 0 19553 0 18792	646 9 653 1 659 5 665 9 672 4	505] 196 6 486 7 476 4 465 7	1153 2 1149 8 1146 1 1142 2 1138 1	0 8403 4 5458 0 8514 0 8571 0 8628	0 4689 0 4583 0 4474 0 4364 0 4251	1 3141 1 3092 1 3041 1 2988 1 2934 1 2879	676 8 674 8 678 8 678 8
40	2059 9 2118 3 2178 1 2279 2 2301 7	0 0 2 5 2 5 0 0 0 2 5 5 7 0 0 0 2 5 9 1 0		0 18021 0 17259 0 16534 0 15816 0 15115	679 1 685 9 692 9 700 0 707 4	454 6 443 431 4(8.7 405 7	1133 7 1129 0 1124 0 1118 7	0 8686 0 8746 0 8806 0 8668 0 8931	0 4134 0 4015 0 3893 0 3767	1 2821 1 2761 1 2699 1 2634 1 2567	636 6 646 8 646 8 657 8
4 0 4 0 7 1 5 0	2365 7 2431 1 2498 1 2566 6 2636 8	0 02911 0 0 02958 0 0 02911 0	10947 10229 09514	G 14431 0 13757 0 13087 0 12424 0 11769	714 9 772 9 731 5 740 2 749 2	392 1 377 7 362 1 245 7 328 5	1107 0 1100 6 1093 5 1085 9 1077 6	0 8995 0 9064 0 9137 0 9212 0 9287	0 3502 0 3361 0 3210 0 3054	1 2498 1 2425 1 2347 1 2756 1 2179	656 8 564 0 564 0 668 0 677 8
	2708 6 2782 1 2957 a 2931 5 3013 4	003114 0 003204 0 003313 0	07349 06595 05797	0 11117 0 10463 0 09799 7 09110 0 08371	758 5 768 2 778 8 790 5 804 4	310 ! 290 Z 268 Z 243 I	1068 5 1058 4 1047 0 1033 6 1017 2	0 9365 0 9447 0 9535 0 9634	0 2720 0 2537 0 2337 0 2110	2086 1984 1872 1744	676 6 686 6 684 6 642 0 697 0
8 8 7 9 4 0 5 8 5 4 1 *	3094 3 3135 5 3177 2 3198 3 3208 2	0 0 4 1 0 8 0 0 0 0 4 1 0 8 0 0	031/3 (0 07519 0 06997 0 06100 0 05730	822 4 835 0 854 7 873 0	172 7 144 7 102 0 61 4 0 0	995 2 979 7 956 2 934 4 906 0	0 9901 1 005 1 0169 1 0329	0 1490 1 0 1216 1 0 0876 1 0 0527 1	1390 1252 1266 0856 0612	706 8 707 9 704 9 705 6

*Critical temperature

WEST TO

70.

		- Sau	Tab	74		Enthalgy			Entropy	***	Abs Pract
LD. Sq in	Fahr I	Sat Liquid	Evan	Sat Vapor *£	Saf Liquid hy	Evap	A E	Sat Liquid S.	tva0	Sat V300r S 2	Lt Sq in
0 CS065 0 75 0 30 1 0 5 0 10 0 14 696 13.6	17 018 56 123 79 596 101 14 163 24 193 21 212 00 213 03	0 016027 0 016027 0 016027 0 016136 0 016407 0 016592 0 016726	3302 4 1235 5 641 5 333 59 73 515 38 404 26 782 26 274	1302 4 1275 5 641 5 133 60 71 532 18 420 26 799 26 290	0.0003 27.182 47.623 59.73 130.20 161.76 180.7	1075 5 1060 1 1048 6 1036 1 1000 9 982 1 970 3 969 7	1075 5 1087 4 1096 3 1105 8 1131 1 1143 3 1150 5 1150 9	0 3000 0 0542 0 0925 0 1925 0 2329 0 2836 0 3121 0 3127	18/2 20425 19416 18455 16094 15043 14447 14415	18/2 01/0 9:81 05/2 9:81 05/3 9:81	0 04061 0 75 0 50 1 0 10 0 14 656 15 0
78 8 30 0 40 0 50 0 70 0 70 0 70 0 70 0 70 0	27 % 250 34 257 25 281 02 292 71 102 93 112 04 120 28	0 015834 0 01 009 0 01 7151 0 01 7274 0 01 783 0 01 783 0 01 785 0 01 785	20 070 13 7256 10 4794 8 2967 7 1562 6 1875 5 4536 4 8779	20 087 13 7436 10 4965 8 5140 7 1736 5 2050 5 4711 4 8953	196 27 218 9 236 1 250 2 262 2 272 7 252 1 290 7	950 1 945 2 933 6 923 9 915 4 907 8 900 9 894 6	1156 3 1164 1 1169 8 1174 1 1177 6 1180 6 1153 1 1185 3	0 1358 0 1567 0 3921 0 4112 0 4273 0 4414 0 4534	1395 1313 1324 1327 1305 1575 1470	17379 14995 15145 15346 15346 16208 16113	29 8 12 8 48 4 18 0 68 5 12 0 48 5 19 5
188 8 118 3 128 8 138 8 146 8 158 8 164 8 178 8	J27 82 334 79 341 27 J47 33 353 04 358 43 363 35 368 42 377 08 377 53	0 017740 0 01782 0 01789 0 01799 0 01893 0 01809 0 01815 0 01827 0 01827	4 41 33 4 0306 3 7097 3 4364r 3 2010 2 9953 2 8155 2 6556 2 5129 2 3847	4 4310 4 0484 1 7275 3 4544 J 2190 3 0139 2 5336 2 6738 2 5312 2 4030	298 5 305 8 312 6 319 0 325 0 336 6 336 7 341 2 346 2 350 9	888 6 853 1 877 8 872 5 868 0 863 4 859 0 854 8 850 7 846 7	1187 2 1188 9 1190 4 1191 7 1193 0 1194 1 1195 1 1196 9 1197 6	0 4743 0 4834 0 4919 0 4919 0 5071 0 5141 0 5159 0 5334	11134 11115 10950 10815 10631 10554 10435 13322 13215 13113	1 5950 1 5879 1 5813 1 5752 1 5695 1 5591 1 5591 1 5543 1 5498	128 6 110 0 120 8 130 8 130 8 150 8 150 8 160 0 160 0
298 8 278 8 278 8 278 8 278 8 278 8 278 8 278 8 278 8	381 80 355 91 359 88 393 70 397 39 400 97 404 44 407 80 411 80 411 80 411 80	0 01339 0 01344 0 01850 0 01855 0 01865 0 01865 0 01875 0 01875 0 01885	2 16373 2 16373 2 16373 2 16779 1 37999 1 87352 1 75548 1 69137 1 63169 1 57597	2 7873 2 18217 2 05629 1 99846 1 91769 1 84317 1 77418 1 71013 1 65049 1 59482	- 355 5 359 9 364 2 368 3 372 3 376 3 379 9 387 1 390 6	847 8 839 1 835 4 931 8 828 4 825 0 821 6 818 3 815 1 812 0	1198 3 1199 6 1200 1 1200 6 1201 1 1201 5 1201 9 1202 3 1202 6	0 54.78 0 54.90 7 55.88 0 56.79 0 57.72 0 5.764 0 58.44	1 0015 0 9923 0 9934 0 9748 0 9665 0 9539 0 9433 0 9391	5413 5214 5336 1529 1529 1529 1529 1529 15197	200 0 210 0 210 0 210 0 240 0 250 0 250 0 250 0 250 0 250 0
706 8 258 8 400 8	41735 43173 444 60	0 01889 0 01912 0 01934	1 52384 1 30642 1 14162	1 54274 1 32554 1 16095	394 0 409 8 424 2	603 9 794 2 780 4	1202 9 1204 0 1704 6	0 5882 0 9059 0 6217	0 9222 0 4909 0 8630	1 2344	200 6 250 8 460 8
456 0 508 6 156 6 608 8 656 8 708 6	456 28 467 01 476 94 486 20 494 89 503 08	0 01954 0 01975 0 01976 0 02013 0 02032 0 02050	1 01224 0 90787 0 82183 0 74962 0 68811 0 63505	1 031 79 0 97762 0 841 77 0 76975 0 70843 0 65556	437 3 449 5 460 9 471 7 481 9 491 6	767 5 755 1 743 3 732 0 730 9 710 2	1204 8 1204 7 1204 1 1203 7 1202 8 1201 8	0 6360 0 6490 0 6611 0 6773 2 6879 0 6978	0 9378 0 8128 3 7915 0 775 0 7552 0 7377	1 4738 1 4639 1 347 1 4461 1 4181 1 1 104	450 0 500 0 550 0 600 2 550 0 700 0
758 6 868 8 858 9 964 0 958 6 1000 8 1158 8 1158 8 1200 8	510 84 518 21 525 24 531 95 538 39 540 51 550 51 556 28 561 82 567 19	0 02069 0 0208/ 0 02105 0 02123 0 02141 0 02159 0 02117 0 02195 0 02214	0 54880 0 54809 0 51197 0 47968 0 45064 0 42067 0 17853 0 15859 0 14013	0 60949 0 56496 0 53302 0 50071 0 47705 0 44596 0 42724 0 40058 0 38073 0 36245	500 9 509 8 518 4 526 7 534 7 547 5 550 1 557 5 564 8 571 9	599 8 689 6 679 5 669 7 660 0 550 4 640 7 131 5 622 2 613 0	1200 7 1199 4 1198 0 1196 4 1194 7 1192 9 1191 0 1189 1 1187 0 1184 8	0.7022 0.71:1 0.7197 0.7279 0.7258 0.7474 0.7507 0.7578 0.7578 0.7714	0 7210 0 7541 0 5899 0 5 53 0 6612 0 5341 0 5091 0 5969	14032 141+3 140% 1407 13070 13070 13070 13073 13738 13643	718 8 800 0 850 0 950 0 950 0 1000 0 1000 0 1150 0 1150 0
1756 9 1200 0 1200 0 1356 0 1406 0 1456 0 1506 0 1506 0 1600 0 1600 0	572 38 577 42 582 12 587 07 591 70 596 70 600 59 504 87 609 05 613 13	0 02750 0 02759 0 02788 0 02307 0 0237 0 02346 0 02367 0 02387 0 02387	0 32106 0 10/22 0 29250 0 27871 0 25584 0 25172 0 24235 0 23159 0 22143 0 21178	0 32556 0 32791 0 31537 0 30178 0 73711 0 77719 0 75601 0 25545 0 24551 0 23607	579 8 585 6 592 3 598 8 605 J 611 7 618 0 621 2 630 1 636 5	601 8 594 6 585 4 576 5 587 4 558 4 549 4 540 3 522 2	1182 5 1180 2 11/7 8 11/7 8 11/7 8 11/7 1 1167 4 1164 5 1154 5	0 77 90 0 7343 0 7966 0 7966 0 8025 0 8125 0 8127 0 8129 0 8254 0 8199	0 5850 0 5733 0 5507 0 5507 0 5182 0 5182 0 5075 0 4867	1 2530 1 3577 1 3575 1 3474 1 473 1 3171 1 3171 1 3175 1 3176	1750 8 1100 0 1250 0 1450 0 1450 0 1557 0 1600 0 1760 0
1750 8 1800 5 1850 0 1900 0 1950 8 2000 0 2100 6 2700 8 2300 0 3400 0	61712 62102 62483 6.856 632:72 633:30 649.45 653.89 662.11	0 02450 0 02472 0 02517 0 02517 0 02541 0 02565 0 02565 0 02770	9 20263 9 19 90 9 18558 9 1761 9 16999 9 1856 9 1485 9 1603 9 12406 9 11287	0 22713 0 21861 0 21052 2 202:8 0 19540 0 19540 0 18631 0 17501 0 16:772 0 15133 0 14076	642 5 654 5 606 3 672 1 663 8 595 2 719 0	513 1 503 8 494 6 485 2 475 8 466 2 446 7 426 7 426 0 384 8	(155 6 157) 149 0 145 6 142 0 1138) 120 5 113 7	0 #163 0 #470 0 #470 0 #574 0 #574 0 #679 0 #979	0 1/65 0 1559 0 4/54 0 4/54 0 1/54 0 1/54 0 1/54 0 1/40	11.74 10.44 170.40 17941	1750 0 1850 0 1850 0 1950 0 2000 0 2000 0 2100 0 2100 0 2100 0
2500 0 2500 0 2700 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0 2500 0	668 11 6/191 6/193 684 96 690 72 695 13 705 08 705 4/	0 0 2 5 9 9 6 0 3 9 3 6 0 0 3 0 2 9 9 0 3 1 3 4 0 0 3 2 6 2 0 0 3 1 3 5 2 0 2 5 8 1 0 0 4 3 7 2 0 0 5 0 7 8	0 10209 0 09172 0 08165 0 07171 0 06158 0 05073 0 03771 0 0.191	012768 012710 011194 010305 009420 008500 07452 005663 005078	731 7 734 5 757 3 770 7 785 1 801 8 824 0 875 5 906 0	3616 33/6 31/6 31/6 254/ 2184 1693 561	1043 3 108: 0 1069 / 1055 8 1070 3 1070 3 993 3 911 8 906 0	0 9139 0 9217 0 9266 0 9348 0 9728 0 9914 1 0351 1 0612	0 1.706 C 1977 0 1.441 0 2.441 0 1.891 0 1.460 0 C 1.42 0 3000	1 7 3 4 5 1 7 6 7 1 7 6 7 1 7 6 7 1 7 7 7 1 7 8 1 7	7:00 0 2:00 0 7:00 0 7:00 0 7:00 0 7:00 0 7:00 0 7:00 0 7:00 0

*Critical pressure

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P. Beardsley

2.0 Plant Design, Including Safety and Emergency Systems (25.0)

2.1 With regard to the Diesel Generators:

- a. The "Emergency Bypass-Test" selector switch is in "Emergency Bypass" position when a low reactor water level initiation signal is received. Which diesel generator trips would still be operable? (2.0)
- b. Which of these trips would be <u>bypassed</u> if the selector switch was in the "Test" position and the same initiation signal was received? (0.5)

2.1 a. (all 4, 0.5 each)
1. Engine overspeed
2. Generator differential relay
3. Fail to start (incomplete response)
4. Emergency stop pushbutton
b. None
(0.5)

Ref: WNP-2 System and Procedures; DG, pg. 33-35.

To comment

2.2 What safety action(s) are auto-initiated at each of the following indications:

a.	Level 4 (31.5")?	(0.5)
b.	Level 2 (-50")?	(0.5)
с.	1135 psig?	(0.5)
d.	1076 psig?	(0.5)

2.2 a. Runback recirc. flow if only 1 reactor feed pump.

Solicus clarm has safety implication a should be accepted

b. Initiate RCIC and HPCS; trip recirc. pump; initiate

NSSS iso. groups 1, 2, 3, 4 and 7. (0.5)

c. ATWS trip of recirc. pumps. (0.5)

d. 2 MSL S/R valves open (relief mode). (0.5)

Ref: WNP-2 System and Procedures; NBI, pg. 55 and 57;

Main Steam, pg. 32.

a. level 4 may not necessarily be assumed to be en incident with a loss of a RFP.

Level 2 initiative, Not isolation- around are not commonly used at this soile comment history, is: swew, many's ste should be acceptable.

C-no comment of MSRV's open as relief value

2.3 With respect to the <u>Automatic Depressurization System</u> (ADS):

	a. List (including setpoints) the automatic activation sequence for ADS.	(1.5)
confusing	b. Which initiation signal(s) can be cleared by pressing a Seal-In Reset pushbutton(s)?	(1.0)
	c. Which of the signal(s) in (b) can be cleared only if the initiating condition no longer exists?	(0.5)

				Sip scram table	
2.3	a.	3.	Hi drywell pressure (>1.65 psig) Lo water level (level 3: -50") Lo water level (level 1: -129") 105 second timer timed out >1 low pressure ECCS pump (125 psig for RHR/LPCI; 145 psig for LPCS).	(0.3) (0.3) (0.3) (0.3)	
	b.	1.	pts each ADS A(B) reactor pressure vessel low level logic Hi drywell pressure A(B)	(1.0)	
	c.	Hi d	drywell pressure	(0.5)	
	Ref	: WNF	P-2 System and Procedures; AOS, pg. 8-10; 12; and 12	,	

2.4 With regard to the Reactor Protection System:

a.	Which trip(s) can only be bypassed manually?	(1.25)
b.	With regard to the backup scram valves:	
	1. Are they <u>solenoid</u> or <u>air operated</u> ?	(0.5)
	2. To cause a scram, do they: (a) energize or (b) deenergize (if solenoid) (c) pressurize or (d) vent (if air operated) (choose only <u>I</u> answer)	(0.5)
	3. What is their function?	(0.5)

2.4 a (0.417 each) (1.25)

1. APRM Hi-Hi
2. APRM inop.
3. Scram discharge volume Hi level trip

b. 1. solenoid
2. energize (a)
3. bleed air from scram valves (vent header to atmosphere) (0.5)

Ref: WNP-2 System and Procedures; RPS, pg 15, 15, 16; and 30-31, respectively.

a- this question seems to be confusing, other acceptable answers should include the slide links for hypassing non coincident scrams (SRM, ERM, APRM) manual hypass of IRM, SRM. The question should have given a limit (ie 3,4) on answers expected.

b.3 initiate a scram in case of scram pilot value failure

2.5	With r	egard to the AC E	Electrical Distri	bution System:		
	a. Wh	ich <u>lockout</u> relay fferential Curren	will be tripped nt (87TM)?	upon a Transfo	rmer	(0.5)
	b. Li	st three (3) acti lay in (a) is tri	ons which will o	ccur when the 1	ockout	(1.5)
	c. The	e loss of which 4	80V MC bus will cooling?	deactivate both		(0.5)
	d. Who	at happens upon turces for SM-4?	he loss of the n	ormal and start		(0.75)
2.5	a. Uni	t lockout (86XU)				(0.5)
	b. any	3, 0.5 pts each				(1.5)
		Trips and locks Trips 4F circuit Trips main turb De-energizes 86 Starts oscillog Starts computer	oine (20 AST) SXIU graph	eakers rator Exciter Fi	ield Breaker	
	c. MC-	8-B-A				(0.5)
	d. aut	omatic transfer o	of SM-4 to the Di	vision 3 EDG		(0.75)
	10	P-2 System and Pr r a, b, d; AOP 4. . 3 of 4 for c.	rocedures; AC Dis 7.1.9, Loss of F	str.; pg. 15 and Power to SM-8,	1 16	
f - Same	e of control of all all are are	to all of the A lansmer this of any operation	meetin, also howhich shoul	86×4 also try d be accepta	pe 86×14 for	
d. This is to anse	theoul	y section of 2	.5 that the	operator she	ould be e	spected
2.5 b answer 3 locks 5 locks	e list she out excit	outdinclude ! to field breaker in generator &	Closes all 5 bie 4 locks out 500 6 Removes gen	akers 2 tryp & lo	eient on 7 blocks N	Chrs. She trip ann.

2.6 Concerning the Standby Liquid Control System (SLC):

a.	when the SLC System Control Switch is placed in the		
	"Sys A" position?	(1.0	
b.	What is the purpose behind the SLC storage tank heater?	(1.0	
c.	There is a SLC pump trip on low flow (TRUE or FALSE)?	(0.5	

2.6 (any 3, 0.33 each)

a. 1. Both SLC squib-valves fire.
2. RWCU-V-4 isolates.
3. Both SLC storage tank outlet valves open.
4. SLC-P-1A starts (if at least one suction valve is open).

b. Maintains solution temperature high enough to prevent precipitation of the sodium pentaborate.

(1.0)

c. False

(0.5)

Ref: WNP-2 System and Procedures, SLC; pg. 9, 13, 10, respectively.

no comment

Answer the following questions concerning the Low Pressure 2.7 Core Spray System (LPCS):

a.	What is the rated flow of the main LPCS pump?	(0.75)
b.	In shutting down LPCS to standby readiness, is the injection shut off valve (LPCS-V-5) closed before stopping the LPCS pump (Yes or No)? Why?	(1.25)
c.	The check valve located inside the drywell is motor-operated (Yes or No)?	(0.5)
d.	What are the interlocks associated with the auto-opening of the LPCS-V-5 injection valve?	(0.75)

(0.75)

this rest was metasked for

2.7	a.	6350 gpm at 128 psid reactor to suppression chamber.	(0.75)
	b.		(1.25)
		No	(0.5)
	d.	No undervoltage on SM-7 and reactor pressure <470 psig.	(0.75)

Ref: WNP-2 System and Procedures, LPCS; pg. 8, 11-12, 5, and 7, respectively.

b. operators are not required to memorine steps in operating procedures procedures, also, per PPM 2.4.3 (LPCS operating procedure) Page 9 of 15, ren 2 step E 2 and E 4 call for closing discharge nature LPCS-V-5 and then stopping the pump.

d. The only opening condition taught as an interlock is that the presume in the reactor must be less than 470 paig. Power supply to a motor is not considered to be an interlock.

2.8 With regard to the Plant Service Water System (TSW):

pump can be started?

a. What is the purpose of the Chlorine System?

b. What causes starting of the TBCCW pumps and opening of discharge valves?

c. Since TSW provides cooling only to non-essential equipment, why must the plant be shutdown when neither TSW

(0.75)

2.8 a. To inject chlorine to retard the growth of algae within TSW systems. (1.0)

b. Pumps start on low pressure (<80 psig) on alternate pump or undervoltage on SM 85 (75) for 15 sec (0.75); discharge valve opens when pump starts if control switch in auto (0.75). (1.5)

c. Because components cooled by TSW are essential for continued operation of the secondary and primary plant. (0.75)

Ref: WNP-2 System and Procedures, TSW; pg. 3, 4 7, respectively.

a. to retard growth of organics should also be acceptable b. time delay should not be required as a specific in the ensuer. also, TSW pump selected for auto start will come on after the diesel has powered its bus on loss of offsite power.

- 2.9 Concerning the <u>CRD Hydraulic System</u>, give the appropriate values for the following:
 - a. Insert drive water pressure at 400 psig reactor pressure. (0.5)
 - b. Cooling water pressure at 400 psig reactor pressure. (0.5)

- 2.9 1. Rx + 260 = 660 psig (0.5)
 - 2. Rx + 20 = 420 psig (0.5)

Ref: WNP-2 System and Procecure's; CRDH; pg. 2.

2- this is taught as Rx + 20 to 30

2.10 Concerning the Condensate Storage and Transfer System (CSTS):

- a. What is the minimum level that must be maintained in CST tanks at all times? (0.5)
- b. Why is this minimum level required? (1.0)

2.10 a. 135,000 gal (6'8")

b. To provide suction for RCIC and HPCS systems to ensure immediate availability of sufficient condensate for ECCS and shutdown (1.0)

Ref: WNP-2 System and Procedures; CSTS; pg. 1 and 13.

no comment

TABLE 1 REACTOR SCRAMS December 1983

			Scram	/ '	po
Scram	First Alarm	Second Alarm	Setpoint	Bypass	Scram Logic
Manual				- /	1/2 twice
Shutdown Mode				. /	1/1 once
SRM Hi-HI	1 x 10 ⁵ cps		2 x 10 ⁵ cps	*Shorting links	1/4 once
				tmstalled	
IRM Inop			- /	In Run Mode	1/4 twice
IRM Hi-Hi	108/125		120/125	In Run Mode	1/4 twice
APRM Hi-Hi	12%		15%	In Run Mode	1/3 twice
APRM Hi-Hi	.66W _R + 42		.66Wp + 51%		1/3 twice
APRM Hi-Hi			118%	Not in "RUN"	1/3 twice
APRM Inop				-	1/3 twice
Scram Discharge	A-525'2-3/8"	527'1-1/2"	529'6" /	In S/D or refuel,	
Volume	B-524'5-13/16"		(and keylock	
				switch bypassed	
Reactor Water			13"		
Level					
Reactor High	102 1 psig		1037 psig		1/2 twice
Pressure					
Drywell High	0.1 psig (low)	1.5 psig	1.68 psig		1/2 twice
Pressure			1 1		.,
MSL High Radia-	1.5 x Normal		3 x Normal		1/2 twice
tion/Inop					.,
MSIV Closure			6% Closed	Not in Run	Any 3/4 MSLs
					isolated
Turbine Throttle			5% Closed	30% Turbine First	
Valve Closure			71.717.77	Stage Pressure	7113 374 1113
Turbine Governor			1250# supply	30% Turbine First	1/2 twice
Valve Fast			oil pressure	Stage Pressure	I/E CWICE
Closure			orr pressure	Judge Fressure	

^{*}NOTE: With Shorting Links <u>removed</u>, <u>any</u> one SRM, IRM, or APRM scram signal from <u>any</u> channel will result in a full scram (non-coincidence logic).

Irwategen

3.0 Instruments and Controls (25.0)

3.1 With regard to the Rod Worth Minimizer System (RWM):

a.	Under what two (2) conditions will the Select Error alarm light be lit?	(1.0)
b.	Above LPAP, what alarms remain operative?	(1.5)
c.	TRUE or FALSE: A rod block is applied upon the second insertion error.	(0.5)

3.1 a. Whenever a selected control rod is not in the currently latched group (0.5) or one currently positioned so as to cause a withdraw or insert error (0.5)

b. Inop/Reset; Withdraw block; Insert block

c. False

(0.5)

Ref: WNP-2, System Description, RWM, pp. 18, 20, 18, respectively.

b. your answer is true only for a hardware failure (Ref pp 20 above) this question amount do not otherwise - during its normal function- no alarme are operable, which should be acceptable answer since hardware failure was not adhessed.

3.2 For the events listed, match the action(s) that will occur in the Recirculation System. Assume that the pumps are running in high speed. (An action may be used more than once)

(2.5)

Events:

- Suction or discharge valves <90% open
 Vessel hi presssure (ATWS)
 Feedflow <30% with FCV <18% open

- 4. Reactor vessel low level (Level 3)
- 5. RPT

Actions:

- a. Fast Speed Trip
- b. Slow Speed Trip
- c. LFMG start.

3.2 (0.5) each 1. A, B 2. A, B 3. A, C 4. A, C 5. A, C

(2.5)

Ref: WNP-2, RRC, pg. 39.

3.3 According to Monthly Operational Bulletins:

- a. How did the failure, on two shifts, to check chart movement on wetwell level recorder CMS-LR/RR-4 contribute to loss of wetwell level? (1.0)
- b. Why is it important to ensure that <u>local</u> temperature indicators at the <u>nitrogen</u> supply shed and in the reactor building are monitored? (1.0)

- 3.3 a. The recorder had been, in fact, inadvertently de-energized so that annunciator alarm switches activated by the recorder pen were also 0.0.S. (1.0)
 - b. No control room monitors exist. If nitrogen temperature gets too low, nitrogen flow onto a 30 in. dia. containment purge header and onto wetwell and drywell purge liner inside containment could cause failure through nitrogen embrittlement. (1.0)

Ref: WNP-2 Monthly OP Bull: April-May, pg. 1; Feb-Mar, pg. 6, respectively.

ast Unfair question:

MOBS are covered as part of the License Reguel Training NOT as part of Hot cicuse Training and thurse the operator may not have real this. 26 See response for questin # 8.9

8.89

3.4 In reference to the Source Range Monitors (SRM):

a. What two (2) types of radiation are separated by the pulse height discriminator (PHD)? Which one causes an output signal from the PHD? (1.0)

b. Indicate (by Yes or No) whether the following trip circuits in the SRM electrical circuitry will generate a signal for use in the RMCS rod block circuitry: (3.0)

1. Downscale

2. Retract Permit

3. Upscale High

4. Upscale High High (shorting links installed)

5. Inop.

6. Reactor period.

3.4 a. Neutron and gamma radiation (0.5); neutrons cause output (0.5)

b. (0.5) each
1. Yes
2. Yes
3. Yes
4. No
5. Yes
6. No

Ref: WNP-2, System Description, IRM, pg. 14 and 28, respectively.

or

- 3.5 With regard to the Reactor Manual Control System (RMCS):
 - The accumulation light starts <u>flashing</u>:

 What is the <u>cause(s)</u> of this?
 What causes the light changing to "steady on"?
 - b. In mode 5 under what conditions, and in what manner will Select block be indicated? (1.5)
 - c. Can an <u>overtravel alarm</u> be received if the control rod is connected to its drive unit (<u>Yes</u> or <u>No</u>)? (0.5)

3.5 a. 1. High-level (5 cc) or low N₂ pressure (970 psig) (0.75)
2. Operator acknowledges alarm with "Accumulation Trouble Acknowledge" pushbutton (0.75)
b. Any rod is not fully inserted (0.75); SELECT BLOCK amber light (0.75)
c. No. (0.5)
Ref: WNP-2, System Description, RMCS, pp. 7, 11, and 18,

respectively.

a. setpoints were not asked for in question b. also accept " If the operator withdraws one control rod.

3.6	With	regard	to	the	RCIC	system:

2.

a.	RCIC pump flow indicator RCIC-FIS-2 has two contacts.	
	What is the purpose of each contact?	(2.0)

b. For monitoring steam flow to the RCIC turbine:

 How many differential pressure switches (DPS) are used to monitor steamflow? (0.5)

2. Where are they located? (0.75)

c. Should the RCIC-V-8 and RCIC-V-63 keylocked control switches be left in OPEN or CLOSED position when resetting any isolution signal? (0.5)

(0.75)

c. Open _ wrny! (0.5)

Ref: WNP-2, System Description, RCIC, pp. 27, 27; and SOP 2.4.6, pg. 2 of 29, respectively.

a. Heis question is not realistic — operators

do not memorial FIS switch numbers!!

and nor the member of contents and each one's

specific function — but the function as viewed from his indicators.

b. 2 Should also accept, to all located on flow

elbours insede drywell

C. they Should be in "Close" position (RG PPM 2.4.6 Reval

- 3.7 Concerning vessel instrumentation, state whether the following are TRUE or FALSE:
 - a. The Fuel Zone Range level indicators are calibrated cold. (0.5)
 - b. Level 1 (-128") will initiate NSSSS isolation groups: 1, 2, 3, 4, and 7. (0.5)
 - c. The reference leg design of the Level Indicators have been designed to compensate for extreme temperature transients. (0.5)
 - d. Jet pumps 5, 10, 15, and 20 were individually flow calibrated prior to installation. (0.5)
 - e. Pressure measured at the core inlet plenum is also used as input to the CRDH system. (0.5)

- 3.7 (0.5) each (2.5)
 - a. False
 - b. False
 - c. False
 - d. True
 - e. False

Ref: WNP-2, System Description, NBI, pp. 57, 56, 5, 7, and 33, respectively.

- 3.8 With regard to the Power Range Neutron Monitoring System (PRMS):
 - a. What four (4) subsystems make up the PRMS? (0.75)
 - b. Which three (3) trips are input to RPS from the PRMS? (0.75)
 - c. For what two (2) conditions and for which components do the white indicators next to the heat flux meters below the full core display become lit? (0.75)

- 3.8 a. RBM, Flow Unit System, APRM, LPRM (0.75)
 - b. APRM upscale thermal, APRM upscale neutron, inop. (0.75)
 - c. Failed (0.25) bypassed conditions from LPRMs associated with rod selected (0.25). (0.75)

Ref: WNP-2, System Description: LPRM, pg. 1; APRM, pg. 36; LPRM, pg. 4; respectively.

- b. also accept 15%. APRM u/s trip is with Morle Sw. in Startup
- C. Manual Bypess or Reviphent rod selected or APRM Ref signal 230%. For the RBM system (Ref 5+P RBM P\$ 33 1/6/II Tab 7)

3.9 Which type of detector (scintillation, ion chamber, fission chamber or Geiger Mueller) is used in the following process radiation measurements?

a.	Main steam line	10.51
b.	Off-gas post-treatment	(0.5)
	Reactor building main exhaust	(0.5)
	The state of the s	(0.5)

3.9 a. Ion chamber (0.5)
b. Geiger-Mueller (0.5)
c. Gieger-Mueller (0.5)
Ref: WNP-2 Syst. Descript., PRM, pg. 4, 3, 4, respectively.

OK

TC. Messersmith

4.0 Procedures - Normal, Abnormal, Emergency and Radiological Control (25.0)

1		
4.1	With regard to General Operating Procedure 3.1.2, Reactor Plant Cold Startup:	
*	a. What action(s) should the operator take to prevent RWCU pump trip on low flow.	(1.0)
/ /	b. Why should you avoid heat-up rates that demand a high reject temperature .	(1.0)
1	c. How will RPV water level stability be indicated?	(1.0)
	Weighted tookeavily for a single paragraph one operating procedure.	out o
1		
4.1	a. By adjusting reject valves RWCU-V-31 and V-33 as required.	(1.0)
4	b. This will cause high RWCU F/D inlet temperatures and RWCU F/D isolation at 140°F.	(1.0)
	c. By a small output signal on the RFW-FCU-10 controller.	(1.0)
	Ref: WNP-2 PPM 3.1.2., pg. 8 of 18.	

4.2 With regard to performing <u>Rod or Minimizer</u> (<u>RWM</u>) <u>initiation</u> in accordance with the System Operation Procedures for <u>RWM</u> (2.1.4):

a. How does the operator verify the RWM is not in "rod test"? (1.0)

b. What happens when the INOP/RESET pushbutton is depressed before the "System Initialize" pushbutton is depressed? (1.0)

c. What happens when the INOP/RESET pushbutton is depressed after the system is initialized? (1.0)

4.2 a. By depressing the TEST/SELECT button, observing illumination, depressing again and observing the light goes out. (1.0)

b. Any previous alarm ("Comp/Progam") is reset, the Comp light and the RWM/Program lights are illuminated. (1.0)

c. The RWM and program lights extinguish. (1.0)

Ref: WNP-2 SOP 2.1.4, pg. 2-3 of 3.

Comments:

1. This procedure is not used for operation of the RWM. The volume 7 surv. procedure is used to verify RWM operability and to operate that piece of equipment.

2. Does not assess the operators knowledge of system operation. It check's which lights come on or off. ?

3. Wrote memorization of procedures not reg'd per Examiners standard 202, B-4.

- 4.3 Relative to the Emergency Operating Procedure for RPV Pressure Control (RPV/P)(5.1.2):
 - a. List any three (3) of the five entry conditions. (1.5)
 - b. What are the four (4) systems to be used to augment the main turbine bypass valves for controlling pressure below 1075 psig? Give any limiting condition on the use of these systems. (3.0)

a. any 3; 0.5 points each

(1.5)

1) RPV water level below +13.0 in.

2)

RPV pressure >1037 psig Drywell pressure >1.68 psig

4) A condition requiring MSIV isolation

5) A condition requiring reactor scram and power is above 5% or cannot be determined.

b. (3.0)

1) SRV's (0.6), if suppression pool water level >17 ft (0.3)

RCIC (0.6) 2)

3) RWCU (recirculation through heat exchanger and blowdown modes) (0.6); if no boron has been injected into RPV (0.3)

4) Main steam line drains ((MS-V-16, -19, -21) (0.6)

Ref: WNP-2 EOP 5.1.2, pp. 1 and 6-7 of 8.

Valve #'s
Should hot be regid
for full credit.

- 4.4 a. The plant is in the process of starting up (Condition 2) with all systems and components normal except that the "A"

 IRM has previously failed high and was subsequently bypassad.

 The "E" IRM now loses power and is declared inoperative. May the plant continue in this condition for an extended period of time without being in violation of Tech. Specs? Also give the appropriate action statement. (1.5)
 - b. Could you place the mode switch in run (Condition 1) to bypass the action statement in part "A"? (0.5)

4.4 a. Yes (0.5); place the RPS A channel in the tripped position within one hour (1.0). (1.5)

No (0.5).

Ref: WNP-2 1/S, pp. 3/4 3-1; 3/4 0-1, respectively.

per Tech. Spec. on IRM operability the provision of Tech. Spec 3.0.4 is not applicable for this action statement!

- Assuming a loss of feedwater heaters while operating at 100% 4.5 power, according to Abnormal Operating Procedure 4.2.7.2:
 - Give three (3) of the four events that could have caused (2.25)
 - What change would you expect to see in the Main Generator MW (increase, decrease)? (0.5)
 - c. What is the first immediate operator action you should take? (0.75)

4.5 a. (Any 3 @ 0.75 each)

(2.25)

1. Heater isolation on high water level.

2. Turbine trip.

- (System malfunction resulting in the) isolation of or more feedwater heaters.
- (System malfunction resulting in the) closure of extraction stram line valves for one or more feedwater
- Increase (on a tueb. terp, you don't worry about this (0.5)

 Reduce reactor power via recirculation flow control every (0.75)

Ref: WNP-2 AOP 4.2.7.2, pg. 1 of 2.

turbine teip.

only answer # 1 is found in the abnormal Procedure listed as reference. # 2 is not even applicable, # 3 x 4 are the same thing and they result from #1,

4.6 With regard to the operating procedure for 250V DC Distribution System (SOP 2.7.7), give any three (3) of the four indications that the operator will have if the tie to distribution bus S2-1 has been completed.

(2.25)

4.6 (Any 3 @ 0.75 each)

(2.25)

- "250 VDC LOSS, BATT B2-1 FAIL" alarm on board "C" in Control Room clears.
- "250V VDC BATT B2-1 GND" alarm on board "C" remains cleared.
- 3. Bus S2-1 voltage reads 220 to 250V on board "C".
- 4. Bus S2-1 ground lamps on board "C" are on.

Ref: WNP-2 LSOP 2.7.7, pg. 2 of 5.

this question requires total recall of procedure. This is not reg'd per Examiner's Standard 202.8-4 (pg 20 f6)

4.7 Reactor coolant leakage into the primary containment from unidentified sources shall not exceed (1) gpm and the total coolant leakage shall not exceed (2) gpm. (1.0)

4.7 1. 5 gpm (0.5)

2. 25 gpm (0.5)

Ref: WNP-2 Tech Specs., pg. 3/4 4-9.

4.8 The Reactor Operator reports that "GEN BUS DUCT TEMP HIGH" and "GEN BUS DUCT CLR FLOW LOW" have activated and that bus duct temperatures are increasing. The <u>failure</u> of <u>which</u> component(s) is the most probable cause?

(1.0)

4.8 The TSW solenoid supply valve
Ref: WNP-2 AOP 4.5.6.1, pg. 2 of 2.

(1.0)

4.9 According to AOP 4.8.3.2 "Loss of all RCCW," if no RCCW pumps can be started during power operation, a rapid increase will occur in (Fill in). (0.5)

4.9 Drywell pressure

(0.5)

Ref: WNP-2 AOP 4.8.3.2, pg. 3 of 3.

4.10 According to the Abnormal Operation Procedures for Fires (4.12.4.1), one indication, other than fire alarm, will be fire header pressure fluctuation (TRUE or FALSE)?

(0.5)

4.10 True

(0.5)

Ref: WNP-2 AOP 4.12.4.1, pg. 1 of 2.

4.11 According to the Limitations stated in the Operating Procedures for the Reactor Core Isolation System (SOP 2.4.6), what must you do if manual isolation is required at any time that system initiation is not sealed in?

(0.75)

4.11 Close the isolation valves using their respective control switches.

(0.75)

Ref: WNP-2 SOP 2.4.6, pg. 2 of 28.

4.12 With regard to Administrative Procedures:

- a. There must be two (2) licensed operators in the Control Room at all times (TRUE or FALSE)? (0.5)
- b. During new fuel handling operations, a licensed operator must be on the refueling floor (TRUE or FALSE)? (0.5)

4.12 a. False (0.5)

b. False (0.5)

Ref: WNP-2 Admin. Proc: 1.3.2, pg. 3 and 6.2.3, pg. 2, respectively.

This could easily be confused with the licensed operator requirement of T.S. G.Z.Z.d. which require an sko for care alts.

Should give credit for a true answer as well.

4.13 According to Standing Order/Night Orders (Admin. Proced. 1.3.1), under what conditions can the reactor operator shut the reactor down without being instructed by the Shift Manager or required by the Emergency Procedures? (1.0)

4.13 When safety of reactor is in jeopardy or when operating parameters exceed any RPS setpoint and autoshutdown does not occur.

(1.0)

Ref: WNP-2 Admin. Proc. 1.3.1, pg. 2.

.

4.14 With regard to the <u>Health Physics Program</u>, what are the whole body exposure limits for the following:

(1.0)

- a. Administrative exposure limits (day, quarter, year)
- b. Lifesaving actions

. 1: .

4.14 1. 300 mrem/day (0.17); 1000 mrem/quarter (0.17); 5000 mrem/year (0.16)

2. 75 rem (0.5)

(1.0)

Ref: WNP-2 Health Physics Program, 3.1.5, pg. 4 of 5.

quarterly limit is 1250 mm/gtR see PPM 1.11.3, pg 3.f25