APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Operator Licensing Examination Report No. 50-285/OL 92-01

Operating License No. DPR-40

Licensee: Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247

Examinations at: Fort Calhoun Station

Examinations Conducted: Week of 22 June, 1992

Chief Examiner: K. M. Kennedy, Examiner, Operator Licensing Section
Division of Reactor Safety

Approved by: Samuel J. Collins 7/24/92
S. L. Pellet, Chief Date
Operator Licensing Section
Division of Reactor Safety

Summary

NRC Administered Examinations Conducted During the Week of June 22, 1992
(Examination Report 50-285/OL 92-01)

NRC administered examinations to three reactor operator applicants and seven senior reactor operator applicants. All applicants passed all portions of the examination and have been issued the appropriate license.

DETAILS

1. PERSONS EXAMINED

		SRO	RO	Total
Licensee Examinations:	Pass -	7	3	10
	Fail -	0	0	0

2. EXAMINERS

K. M. Kennedy, Chief Examiner
F. Victor
G. Weale

3. EXAMINATION REPORT

Performance results for individual examinees are not included in this report as it will be placed in the NRC Public Document Room and these results are not subject to public disclosure.

3.1 Examination Review Comment/Resolution

In general, editorial comments or changes made as a result of facility reviews prior to the examination, during the examination, or subsequent grading reviews are not addressed by this resolution section. This section reflects resolution of substantive comments submitted to the NRC by the facility licensee after the examination. The facility licensee post-examination comments, less the supporting documentation, are included in the report immediately following the master examination key. All five facility licensee comments were accepted.

3.2 Site Visit Summary

The facility licensee was provided a copy of the examination and answer key for the purpose of commenting on the examination content validity. The facility licensee was informed that examination results could be expected within 30 days of the completion of the examination.

The NRC met with members of the licensee's training staff and summarized the results of the examinations as presented in this report. The following personnel were present:

NRC	FACILITY	
K. M. Kennedy	J. K. Gasper	C. F. Simmons
R. V. Azua	G. E. Guliani	J. J. Tesarek
	J. B. Herman	D. R. Trausch

3.3 General Comments

3.3.1 Written Examination

The average score on the reactor operator examination was 91 percent and the average score on the senior reactor operator examination was 86 percent. Seven questions on the examination were missed by 50 percent or more of the applicants. The question numbers for these seven questions are provided to assist facility evaluation of training weaknesses.

RO 10 / SRO 10	RO 43 / SRO 32
RO 16 / SRO 14	RO 48 / SRO 35
RO 18 / SRO 16	RO 74 / SRO 49
RO 22 / SRO 19	

3.3.2 Operating Examination

The applicants' performance of the job performance measures was a noted strength. Of the 80 job performance measures administered to the applicants during the plant walkthrough portion of the examination, 79 were performed satisfactorily.

3.4 Master Examination and Answer Key

A master copy of the written examination and answer key is attached. The post-examination comments, which have been accepted, are incorporated into the answer key.

3.5 Simulation Facility Report

All items on the attached Simulation Facility Report have been discussed with the facility personnel.

SIMULATION FACILITY REPORT

Licensee: Omaha Public Power District

Docket No: 50-285

Operating Tests Administered at: Fort Calhoun Station

Operating Tests Administered: Week of June 22, 1992

This report does not constitute an audit or inspection and is not, without further verification and review, indicative of non-compliance with 10 CFR Part 55.45(b). These observations do not affect NRC certification or approval of the simulation facility other than to provide information which may be used in future evaluations. No licensee action is required in response to these observations.

During the conduct of the operating examinations identified above, the following items were observed:

- The emergency response facility computer system failed to indicate lower than normal steam line flow in response to a failure low of steam generator steam pressure transmitter PT-907.

- The high pressure safety-injection header number two discharge valve, HCV-2987, could not be fully closed in a post-loss of coolant accident condition.

- The simulator did not accurately model plant response to a simultaneous hot and cold leg injection lineup established in accordance with Emergency Operating Procedure, Attachment 9. Charging flow could not be increased greater than 140 gpm in accordance with Step 10 of Emergency Operating Procedure, Attachment 9.

bcc w/enclosure (except Master Examination and Answer Key):

bcc to distrib. by RIV:

J. L. Milhoan, RA
RIV File
L. Hurley
W. Walker, NRR Project Manager (MS: 11-D-23)
Licensee & Debt Collection Branch, ATTN: Leah Tremper (MNBB 4503)
Section chief (DRP/C)
DRS (J. L. Pellet)
L. Miller, TTC

bcc w/complete enclosure:

bcc to DMB (IE42)
Chief Examiner (K. Kennedy)
Chief Examiner Reading File (L. Berger)

RIV:RE	C:OLS	D:DRS	D:DRP	
KKennedy/lb	JLPellet	SJCollins	ABBeach	
7 /92	7 /23/92	7 /23/92	7/24/92	

RO Question 9/ SRO Question 9

Which ONE of the following should be commenced only AFTER on-coming personnel have assumed the shift?

a. A Pre-Shift briefing for on-coming personnel.

b. Sign the Licensed Operator Shift Turnover Log.

c. Review of surveillance tests or special tests in progress.

d. Review items affecting plant operations by the on-coming and off-going Licensed Operators.

ANSWER: a.

REFERENCE: Fort Calhoun Station SO-O-1, p.58,59,60,61
Both

KA: 194001A103 [2.5/3.4]

OPPD COMMENT

OPPD requests that this question be deleted. None of the choices offered is correct.

Normal operating practice is to accomplish all of the items listed in the choices prior to the on-coming personnel assuming the shift. Choices B,C and D are part of the turnover process and are completed prior to the on-coming personnel assuming the shift.

Current operating practice, as outlined in the attached memo, is for the off-going Shift Supervisor to conduct a pre-shift briefing for the on-coming Shift Supervisor, Operators and STA. This pre-shift briefing is conducted outside the control room and prior to the watchstation turnover. Therefore, choice A is incorrect.

This practice was established on 2/8/92 which was during the License candidates OJT period. A revision to SO-O-1 which reflects the current practice was issued on 6/15/92 and the applicable sections are attached.

REFERENCE: SO-O-1, R5, section 6.1
Memo FC-0170-92

RO Question 58

Which one of the below is the MINIMUM RCS makeup rate that is sufficient to replenish the boil off from decay heat following a loss of shutdown cooling?

a. 15 gpm

b. 55 gpm

c. 1500 gpm

d. 5500 gpm

ANSWER: a.

REFERENCE: AOP-19, p.3
RO only

KA: 005000K301

OPPD Comment

The correct answer to this question is choice B, 55 gpm. The answer key incorrectly lists choice A, 15 gpm, as the right choice.

AOP-19, Loss of Shutdown Cooling, states that "An RCS makeup rate of 55 gpm is sufficient to replenish the boil off from decay heat".

REFERENCE: AOP-19, p.4

SRO Question 74

Personnel entry into a confined space is permitted if toxic gas in the confined space is less than 50 ppm Carbon Monoxide and the confined space atmosphere also meets which ONE of the following conditions?

a. Oxygen concentration is not less than 19.5%; explosive concentration is not greater than 10%.

b. Oxygen concentration is not less than 19.5%; explosive concentration is not greater than 4%.

c. Oxygen concentration is not less than 20%; explosive concentration is not greater than 4%.

d. Oxygen concentration is not less than 20%; explosive concentration is not greater than 10%.

ANSWER: a.

REFERENCE: SO-G-45, p.1
SRO only

KA: 194001K113 [3.3/3.6]

OPPD COMMENT

OPPD requests that this question be deleted.

It is the responsibility of the Chemistry Department to sample the confined space atmosphere, to determine if the oxygen and explosive concentrations are within limits, and to issue the Confined Space Entry Permit. Senior Operator Licensed Individuals and operators under their supervision are required to obtain a Confined Space Entry Permit from Chemistry prior to entry into a confined space.

KA 194001 K1.13 requires knowledge of safety procedures related to an oxygen-deficient environment. Memorization of specific limits is not required since they are listed on the Confined Space Entry Permit.

REFERENCE: FC-1200, "Confined Space Entry Permit"
SO-G-45, paragraphs 1.6.1, 1.6.8, 1.6.9

SRO Question 77

If a women operator declares that she is pregnant and she has already received 600 mrem since conception, which of the following exposure limits apply for the remainder of her pregnancy?

a. No further exposure [0 mrem]

b. 5 mrem

c. 25 mrem

d. 50 mrem

ANSWER: d.

REFERENCE: FCS RP-AD-600, Section 5.6.2, p.7
SRO only

KA: 194001K104

OPPD COMMENT

OPPD requests that the correct answer be changed to choice A, no further exposure.

In General Employee Training, it is emphasized that "OPPD has established a prenatal limit in accordance with Reg. Guide 8.13 of 500 mR/gestation period."

The exposure limit established in RP-602, table 1 and in RP-AD-600 section 5.6.2 is 50 mrem/month and 500 mrem/gestation period. Since the operator has received in excess of 500 mrem/gestation period, she would not be allowed to receive any additional occupational exposure during the duration of her pregnancy.

Note 4 on page 7 of RP-AD-600 establishes the predominance of the 500 mrem/gestation limit over the 50 mrem/month limit for a pregnant worker. The intent of the note is to state that the pregnant worker may NOT be allowed to receive up to 50 mrem/month if that exposure will be in excess of the 500 mrem/gestation period limit.

REFERENCES: General Employee Training, Station Orientation, p. RP17
Regulatory Guide 8.13,"Instruction Concerning Prenatal Radiation Exposure"
RP-602, TABLE I
RP-AD-600, section 5.6.2

SRO Question 82

During power operations, if containment entry is required then the Shift Supervisor and which ONE of the following must approve?

a. Radiation Protection Supervisor OR Operations Supervisor

b. Radiation Protection Supervisor AND Operations Supervisor

c. Plant Manager OR Chemistry and Radiation Protection Supervisor

d. Plant Manager AND Chemistry and Radiation Protection Supervisor

ANSWER: d.

REFERENCE: Fort Calhoun Station IHB: 7-11-8, p.34
SRO only
KA: 103000G001 [3.3/3.9]

OPPD Comment

OPPD requests that this question be deleted. All of the choices offered are incorrect.

According to SO-O-22, "Containment Access and Egress", and RP-213, "Operational Containment Entry", the only authorization required for a containment entry at power is that of the Shift Supervisor. The other positions having responsibilities associated with a containment entry at power are the STA and the Radiological Operations Coordinator.

REFERENCES: SO-O-22, Section 4.0
RP-213, Section 2.0

U. S. NUCLEAR REGULATORY COMMISSION
SITE SPECIFIC EXAMINATION
REACTOR OPERATOR LICENSE
REGION 4

CANDIDATE'S NAME: _____

FACILITY: FT. Calhoun

REACTOR TYPE: PWR-CE

DATE ADMINISTERED: 92/06/22

INSTRUCTIONS TO CANDIDATE:

Use the answer sheets provided to document your answers. Staple this cover sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires a final grade of at least 80%. Examination papers will be picked up four (4) hours after the examination starts.

TEST VALUE	CANDIDATE'S SCORE	%
99.00 ~~100.00~~ KmL	_____	___ % TOTALS
	FINAL GRADE	

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

_____
Candidate's Signature

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001	a	b	c	d	___	023	a	b	c	d	___
002	a	b	c	d	___	024	a	b	c	d	___
003	a	b	c	d	___	025	a	b	c	d	___
004	a	b	c	d	___	026	a	b	c	d	___
005	a	b	c	d	___	027	a	b	c	d	___
006	a	b	c	d	___	028	a	b	c	d	___
007	a	b	c	d	___	029	a	b	c	d	___
008	a	b	c	d	___	030	a	b	c	d	___
009	a	b	c	d	___	031	a	b	c	d	___
010	a	b	c	d	___	032	a	b	c	d	___
011	a	b	c	d	___	033	a	b	c	d	___
012	a	b	c	d	___	034	a	b	c	d	___
013	a	b	c	d	___	035	a	b	c	d	___
014	a	b	c	d	___	036	a	b	c	d	___
015	a	b	c	d	___	037	a	b	c	d	___
016	a	b	c	d	___	038	a	b	c	d	___
017	a	b	c	d	___	039	a	b	c	d	___
018	a	b	c	d	___	040	a	b	c	d	___
019	a	b	c	d	___	041	a	b	c	d	___
020	a	b	c	d	___	042	a	b	c	d	___
021	a	b	c	d	___	043	a	b	c	d	___
022	a	b	c	d	___	044	a	b	c	d	___
						045	a	b	c	d	___

REACTOR OPERATOR

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

046 a b c d ___

047 a b c d ___

048 a b c d ___

049 a b c d ___

050 a b c d ___

051 a b c d ___

052 a b c d ___

053 a b c d ___

054 a b c d ___

055 a b c d ___

056 a b c d ___

057 a b c d ___

058 a b c d ___

059 a b c d ___

060 a b c d ___

061 a b c d ___

062 a b c d ___

063 a b c d ___

064 a b c d ___

065 a b c d ___

066 a b c d ___

067 a b c d ___

068 a b c d ___

069 a b c d ___

070 a b c d ___

071 a b c d ___

072 a b c d ___

073 a b c d ___

074 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

075 a b c d ___

076 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

077 a b c d ___

078 a b c d ___

079 a b c d ___

080 a b c d ___

081 a b c d ___

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

082 a b c d ___

083 a b c d ___

084 a b c d ___

085 a b c d ___

086 a b c d ___

087 a b c d ___

088 a b c d ___

089 a b c d ___

090 a b c d ___

091 a b c d ___

092 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

093 a b c d ___

094 a b c d ___

095 MATCHING

a ___

b ___

MULTIPLE CHOICE

096 a b c d ___

097 a b c d ___

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

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one applicant at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil ONLY to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. Before you turn in your examination, consecutively number each answer sheet, including any additional pages inserted when writing your answers on the examination question page.

8. Use abbreviations only if they are commonly used in facility literature. Avoid using symbols such as < or > signs to avoid a simple transposition error resulting in an incorrect answer. Write it out.

9. The point value for each question is indicated in parentheses after the question.

10. Show all calculations, methods, or assumptions used to obtain an answer to any short answer questions.

11. Partial credit may be given except on multiple choice questions. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

12. Proportional grading will be applied. Any additional wrong information that is provided may count against you. For example, if a question is worth one point and asks for four responses, each of which is worth 0.25 points, and you give five responses, each of your responses will be worth 0.20 points. If one of your five responses is incorrect, 0.20 will be deducted and your total credit for that question will be 0.80 instead of 1.00 even though you got the four correct answers.

13. If the intent of a question is unclear, ask questions of the examiner only.

14. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition, turn in all scrap paper.

15. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

16. To pass the examination, you must achieve a grade of 80% or greater.

17. There is a time limit of four (4) hours for completion of the examination.

18. When you are done and have turned in your examination, leave the examination area (EXAMINER WILL DEFINE THE AREA). If you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION: 001 (1.00)

A 22 year-old licensed male reactor operator has the following exposure history:

- Current quarterly whole body dose: 250 mrem
- Current yearly whole body dose: 4.5 rem
- Current lifetime whole body dose (including current quarter): 19.25 rem

Assuming his exposure is properly documented, what is the MAXIMUM ADDITIONAL whole body exposure this operator can receive THIS QUARTER and still comply with 10 CFR 20?

a. 500 mrem

b. 750 mrem

c. 1000 mrem

d. 1250 mrem

QUESTION: 002 (1.00)

A Reactor Operator has worked the following hours on the dates indicated:

DATE		HOURS WORKED
05/11/92	-	0800 through 2000
05/12/92	-	0800 through 1800
05/13/92	-	0800 through 2200
05/14/92	-	0800 through 2000
05/15/92	-	0800 through 1600
05/16/92	-	0800 through 2000
05/17/92	-	0800 through 2200

On which of the above dates did this operator FIRST violate the overtime requirements? (S.O. G-52-2, Plant Staff Working Hours, is attached for your reference.)

a. 05/12/92

b. 05/14/92

c. 05/16/92

d. 05/17/92

QUESTION: 003 (1.00)

If the HOST MODCOMP of the ERF Computer System failed and the BACKUP MODCOMP is operable, which of the following states how the system is restored to operation?

a. The backup computer takes over when the on-line computer fails.

b. The operator must enter "TRANSFER, EXECUTE", on the ERF Console in the computer room.

c. The operator must enter "RESTORE, EXECUTE", on the ERF Console in the computer room.

d. The operator must enter "BACKUP, EXECUTE", on the ERF Console in the computer room.

QUESTION: 004 (1.00)

Which ONE of the following is assigned as a Fire Brigade member EXCEPT when the fire causes an evacuation of the Control Room?

a. Equipment Operator Nuclear Aux. Bldg.

b. Auxiliary Operator Nuclear.

c. Security Personnel.

d. Licensed Operator.

QUESTION: 005 (1.00)

Which one of the individuals below is NOT permitted to operate reactor controls under the instruction or supervision of a licensed operator?

a. Equipment Operator Nuclear enrolled in a current license training course to obtain an operator license.

b. A licensed reactor operator who recently failed an NRC administered Senior Reactor Operator upgrade examination.

c. A licensed reactor operator whose license has become inactive per the requirements of 10CFR

d. Individual enrolled in a current license training course to obtain an instructor certification.

QUESTION: 006 (1.00)

Which one of the following describes the minimum watchstanding requirements in order to maintain an "Active" license per 10 CFR 55.53, "Conditions of Licenses?"

a. Two 8 hour shifts or one 12 hour shift per calendar month.

b. One 8 hour shift or one 12 hour shift per calendar month.

c. Seven 8 hour shifts or five 12 hour shifts per calendar quarter.

d. Six 8 hour shifts or four 12 hour shifts per calendar quarter.

QUESTION: 007 (1.00)

MULTIPLE CHOICE

When RCS temperature is greater than 400 degrees F, a minimum of _____ individuals are required for Containment entry.

a. Two

b. Three

c. Four

d. Five

QUESTION: 008 (1.00)

If an operator must perform an action or manipulation which is only done infrequently, the operator is required to review the procedure prior to starting the task or to use a copy of the procedure to perform the required actions. In accordance with Standing Order SO-0-1, "Conduct Of Operations", INFREQUENTLY is defined as which one of the following?

a. Less frequent than once every 3 days.

b. Less frequent than once every 7 days.

c. Less frequent than once every two weeks.

d. Less frequent than once every month.

QUESTION: 009 (1.00)

Which ONE of the following should be commenced only AFTER on-coming personnel have assumed the shift?

a. A Pre-Shift briefing for on-coming personnel.

b. Sign the Licensed Operator Shift Turnover Log.

c. Review of surveillance tests or special tests in progress.

d. Review items affecting plant operations by the on-coming and off-going Licensed Operators

Question deleted

QUESTION: 010 (1.00)

In the event of a computer log typewriter failure, parameters which require recording must be logged manually. Which ONE of the following states when this manual recording should be accomplished?

a. Within one hour of the failure and every hour after that.

b. Within two hours of the failure and every hour after that.

c. Within two hours of the failure and every two hours after that.

d. Within three hours of the failure and every hour after that.

QUESTION: 011 (1.00)

An operator assigned to conduct an independent verification of a tag out must be at least qualified to perform which ONE of the following duties?

a. Licensed Operator

b. Auxiliary Operator Nuclear

c. Equipment Operator Nuclear Auxiliary

d. Equipment Operator Nuclear Turbine

QUESTION: 012 (1.00)

Communications with the Control Room is accomplished using the Communications Phone [GAI-TRONICS] or with Portable Radios. Which ONE of the following correctly states which channels are dedicated to the Operations Department?

	GAI-TRONICS	PORTABLE RADIO
a.	Channel 2	Channel 2
b.	Channel 2	Channel 3
c.	Channel 3	Channel 2
d.	Channel 3	Channel 3

QUESTION: 013 (1.00)

Each individual using an operating instruction is responsible for checking the Official Copy to ensure that the most current revision is being used. Which ONE of the following states where an individual would find an Official Copy of a procedure?

a. Electrical Penetration Room.

b. Chemistry Library.

c. Emergency Operating Facility.

d. Training Center Library.

QUESTION: 014 (1.00)

The following indications on the Power Range Nuclear Instrumentation for Channel A are observed:

Upper Detector --- 33%
Lower Detector --- 27%

Which of the following is the Channel A ASI?

a. +0.10

b. +0.06

c. -0.06

d. -0.10

QUESTION: 015 (1.00)

Which of the following control functions or interlocks are provided by the Secondary CEA Position Indication System [SCEAPIS]?

a. Rod Block, Upper Electrical Limit, and Lower Electrical Limit.

b. Rod Withdrawal Prohibit, Regulating Group Withdrawal Prohibit, and Shutdown Group Insertion Permissive.

c. Rod Block, Regulating Group Withdrawal Prohibit, and Shutdown Group Insertion Permissive.

d. Rod Withdrawal Prohibit, Rod Rundown, and Control Rod Sequencing.

QUESTION: 016 (1.00)

If RCS flow is reading 76 on the meter located on CB-3 in the Control Room, which of the following are the units of measurement that are being indicated on this meter?

a. Flow rate in pounds mass per hour [lbm/hr].

b. Flow rate in gallons per minute [gpm].

c. Flow rate as a percent of full flow [%].

d. Differential pressure across the Steam Generator in pounds per square inch differential [psid].

QUESTION: 017 (1.00)

Given the following plant conditions:

- Reactor power level --- 100%
- RCS pressure --- 2160 psia
- RCP seal leakoff --- 1 gpm per pump
- VCT pressure --- 40 psia

If an RCP first stage seal fails, which of the following describes the expected leakoff flow rate and the resultant pressure drop across each operable seal?

a. 1.5 gpm and 1060 psid.

b. 1.2 gpm and 1060 psid.

c. 1.2 gpm and 1080 psid.

d. 1.5 gpm and 1080 psid.

QUESTION: 018 (1.00)

If letdown flow exceeds 155 gpm as sensed by FIC-212 which is located downstream of the Letdown Heat Exchanger [LHX], then Letdown Stop Valve [HCV-204] actuates and isolates flow in the letdown line. The signal from FIC-212 is designed to provide a backup should which of the following signals fail to function?

a. The 550 psig signal from PIC-242 located upstream of the LHX.

b. A 550 psig signal from PIC-243 located upstream of the LHX.

c. A 190 psig signal from PIC-244 located downstream of the LHX.

d. A 190 psig signal from PIC-210 located downstream of the LHX.

QUESTION: 019 (1.00)

Which of the following describes the operation of the VCT Outlet Valve [LCV-218-2] and the Charging Pumps Suction To SIRWT Valve [LCV-218-3]?

a. When VCT level as sensed by LT-219 decreases to 6% or less, both LCV-218-2 and LCV-218-3 receive a close signal.

b. When VCT level as sensed by LCS-218 decreases to 3.2% or less, LCV-218-2 and LCV-218-3 both receive an open signal.

c. A Safety Injection Actuation Signal will open LCV-218-3 and LCV-218-2 will remain open.

d. A Safety Injection Actuation Signal will close LCV-218-2 and LCV-218-3 will remain closed.

QUESTION: 020 (1.00)

In the event of a large break LOCA, which ONE of the following relays MUST actuate to automatically open the CCW Heat Exchanger inlet and outlet valves?

a. SIAS auxiliary relays.

b. CSAS lockout relays.

c. PPLS lockout relays.

d. CPHS lockout relays.

QUESTION: 021 (1.00)

Which ONE of the following partial sets of responses occur when the THINK switches are operated?

a. Containment Isolation Actuation Signal [CIAS], Auxiliary Feedwater Actuation Signal, and Diesel start.

b. Safety Injection Actuation Signal [SIAS], Containment Spray Actuation Signal [CSAS], and Load sequencing.

c. Ventilation Isolation Actuation Signal [VIAS], Steam Generator Isolation Signal, and Diesel Generator breaker protection override.

d. Containment Spray Actuation Signal [CSAS], Containment Isolation Actuation Signal [CIAS], and Recirculation Actuation Signal [RAS].

QUESTION: 022 (1.00)

Which of the following will cause the Power Range Safety Channel "High Voltage" bistable to trip?

a. A 15 VDC signal is applied to the bistable.

b. "Zero-Operate-Calibrate" switch in the "Calibrate" position.

c. Sub-channel linear amplifier "Test Switch" in the OFF position.

d. Detector High Voltage power supply decreases by 10 VDC.

QUESTION: 023 (1.00)

Which of the following WR Log Channels provide Startup Rate, Counts Per Second, and Percent Power indication at the Alternate Shutdown Panel [AI-212]?

a. Channel "B" and "C".

b. Channel "B" and "D".

c. Channel "B" only.

d. Channel "D" only

QUESTION: 024 (1.00)

Which of the following describes the design temperature range for the In-Core Thermocouples?

a. 32 degrees F to 1200 degrees F.

b. 32 degrees F to 2300 degrees F.

c. 100 degrees F to 1200 degrees F.

d. 100 degrees F to 2800 degrees F.

QUESTION: 025 (1.00)

Which of the following operations is initiated by a Containment Isolation Actuation Signal?

a. Opens the Cooling and Filtering Unit face dampers.

b. Opens the Cooling and Filtering Unit bypass dampers.

c. Opens the CCW valves to all unit cooling coils.

d. Starts the Containment Air Cooling fans.

QUESTION: 026 (1.00)

If a high temperature alarm for the charcoal bed of a containment cooling and filtering unit is received, which of the following actions is initiated to quench the charcoal bed?

a. Containment spray header water is manually aligned to the bed.

b. Containment spray header water is automatically aligned to the bed.

c. CCW is automatically aligned to the bed.

d. CCW is manually aligned to the bed.

QUESTION: 027 (1.00)

With the plant at 100% reactor power, which of the following describes the operation of the Condensate Recirculation Valve [FCV-1172] and its effect on plant operations? Assume no operator action.

a. FCV-1172 fails open on a loss of air, which could result in a plant trip.

b. FCV-1172 fails closed on loss of air, which could result in a plant trip.

c. FCV-1172 fails open on a loss of air, but the backup recirculation path will maintain the plant on line.

d. FCV-1172 fails closed on loss of air, but a plant trip is avoided since interlocks will cause the Condensate Makeup Valve [LCV-1190] to also close.

QUESTION: 028 (1.00)

If a main feed pump motor has tripped due to phase differential, which of the following describes how the trip condition is cleared?

a. Take the Control Room switch on CB-10 to the "OFF" [green flag] position.

b. The phase differential reset flag at the breaker must be manually reset.

c. The phase differential trip will automatically reset when the condition causing the trip has cleared.

d. The lock-out relay on Control Room panel AI-12 must be manually reset.

QUESTION: 029 (1.00)

Which of the following describes the operation of the Main Feed Pump recirculation valves FCV-1151A,B, and C?

a. The valves go full open when feed pump discharge flow decreases to 2500 gpm and modulate closed as pump discharge flow increases to 4150 gpm.

b. The valves modulate open when feed pump suction flow decreases below 4150 gpm and are fully open at 2500 gpm.

c. The valves go full open when feed pump suction flow decreases to 2500 gpm and go full closed when feed pump suction flow increases to 4150 gpm.

d. The valves go full closed when feed pump suction flow decreases below 4150 gpm and go full open when suction flow increases above 4150 gpm.

QUESTION: 030 (1.00)

The LOCAL/REMOTE switch on AI-179 is in the LOCAL position. Which of the following describes the response of the Auxiliary Feedwater System to an AFAS initiation?

a. AFW Control Valves [HCV-1107A & 1108A] will open, but will not close when S/G level is restored to 60% WR.

b. Only the Turbine Driven AFW Pump FW-10 will start.

c. Only the Motor Driven AFW Pump FW-6 will start.

d. Both AFW Pumps will start and all four AFW Control Valves [HCV-1107A,B & 1108A,B] will open.

QUESTION: 031 (1.00)

Which of the following automatic actions will occur if a high radiation alarm is actuated on RM-055 or RM-055A?

a. Overboard Discharge Flow Control Valves [HCV-691 & 692] will close and the Monitor Tank Pumps trip.

b. High Radiation alarm on AI-100 actuates and Monitor Tank Inlet Valves [HCV-672 & 678] close.

c. Reactor Coolant Drain Tank Pumps stop and Overboard Discharge Flow Control Valves [HCV-691 & 692] close.

d. Monitor Tank Inlet Valves [HCV-672 & 678] close and Monitor Tank Pumps trip.

QUESTION: 032 (1.00)

The Gas Decay Tank is being released via the plant stack when Ventilation Air Particulate Monitor [RM-61] "FLOW FAULT" light actuates and the gas release is terminated. With RM-61 out of service, the gas release may be resumed under which ONE of the following conditions?

a. If both the Ventilation Iodine Monitor [RM-60] and the Ventilation Gas Monitor [RM-62] are in service.

b. If Containment Air Particle Monitor [RM-50] is in service.

c. After reducing gaseous flow discharge rate by at least 30 SCFH.

d. After RM-50 and RM-51 are aligned to monitor the stack and actuation setpoints have been reset.

QUESTION: 033 (1.00)

If the "B" Steam Generator Blowdown Monitor [RM-54B] alarms high, which of the following describes the automatic actions that will occur?

a. Blowdown and blowdown sample flow from only the "B" S/G will isolate.

b. Blowdown and blowdown sample flow from both the "A" and "B" S/Gs will isolate.

c. Only the S/G Blowdown Outside Containment Isolation Valves [HCV-1387B and 1388B] will close.

d. Blowdown Sample Discharge Valve [HCV-2508] diverts the discharge flow path from the raw water system to the radioactive waste disposal system.

QUESTION: 034 (1.00)

Which type of detector is used in most of the plant Area Radiation Monitors?

a. G-M detectors.

b. Ion Chamber detectors.

c. Beta Scintillation detectors.

d. Sodium Iodide detectors.

QUESTION: 035 (1.00)

With an AFAS signal present, which of the following conditions could result in water hammer while controlling steam generator level using the auxiliary feedwater nozzles?

a. Placing hand controllers for HCV-1107B and HCV-1108B at CB-10/11 in the CLOSED position before taking their respective control switches at AI-66A/B to the CLOSED position.

b. Placing hand controllers for HCV-1107B and HCV-1108B at CB-10/11 in the OPEN position before taking their respective control switches at AI-66A/B to the CLOSED position.

c. Controlling steam generator level greater than 94% Wide Range in automatic control.

d. Controlling steam generator level greater than 85% Narrow Range in manual control.

QUESTION: 036 (1.00)

Which ONE of the following describes the correct operation of the CEDM brake?

a. It is de-energized when the Mode Selector Switch is in the Manual Group position.

b. When the brake is energized the CEDM motor is free to rotate.

c. The brake must be de-energized to allow CEA movement after an RPS trip.

d. It is energized when the RPS is reset.

QUESTION: 037 (1.00)

If the Regenerative Heat Exchanger Letdown Isolation Valve [TCV-202] closes due to an erroneous high temperature signal, which of the following actions would cause the valve to open and remain open?

a. Transfer to LOCAL control at the Alternate Shutdown Panel [AI-185] and check TCV-202 control switch in the OPEN position.

b. Transfer to LOCAL control at the Alternate Shutdown Panel [AI-43A] and place TCV-202 control switch in the "ENABLE" position

c. Have the plant operator isolate control air to TCV-202.

d. Hold the TCV-202 control switch on CB-1/2/3 in the "OPEN" position.

QUESTION: 038 (1.00)

Why is trisodium phosphate dodecahydrate dissolved in the containment sump water during a LOCA?

a. Minimize the amount of boric acid required to be added to the SIRWT.

b. Minimize crud buildup [fouling] in the Shutdown Cooling Heat Exchangers when used to cool spray water.

c. Minimize the possibility of corrosion cracking of containment components during operation of ECCS.

d. Minimize the amount of hydrogen generated by radiation-induced decomposition of the containment sump water.

QUESTION: 039 (1.00)

All CEAs are fully withdrawn and stationary [not moving]. What color light(s) will be illuminated for the Non-Trippable CRDMs?

a. Green light only.

b. Red light and Amber light.

c. Red light and Blue light.

d. Red light, Amber light and White light.

QUESTION: 040 (1.00)

In the event of an accident, noncondensible gases can be vented from the reactor vessel head using the Reactor Coolant Gas Vent System [RCGVS]. Which ONE of the following describes the flow path for the vented gases?

a. Vented to the Pressurizer Quench Tank only.

b. Vented to the Reactor Coolant Drain Tank only.

c. Vented to the Pressurizer Quench Tank or the Reactor Coolant Drain Tank.

d. Vented to the Pressurizer Quench Tank or Containment Atmosphere.

QUESTION: 041 (1.00)

Which of the following correctly describes the power source for LPSI Pump SI-1B?

a. 4160V Bus 1A3 with normal supply from 161 KV power.

b. 4160V Bus 1A4 with normal supply from 161 KV power.

c. 4160V Bus 1A3 with normal supply from 22 KV power.

d. 4160V Bus 1A4 with normal supply from 22 KV power.

QUESTION: 042 (1.00)

In the event of a loss of power, which ONE of the following will PREVENT the Diesel Generator breakers from automatically closing on their respective 4160V buses?

a. The LPSI pump handswitches are in the AFTER START position.

b. The Raw Water pump circuit breaker is closed.

c. The LPSI pump 69 permissive switches on the switchgear are NOT in the PERMISSIVE [green flag] position.

d. A Recirculation Actuation Signal [RAS] is present and the LPSI pump recirc override keyswitches are in the OVERRIDE position.

QUESTION: 043 (1.00)

Given the following conditions:

Pressurizer Level Selector Switch --- selected to channel X
Pressurizer Level Channel Defeat Switch --- selected to channel X/Y

If Pressurizer Level Sigma Meter LIC-101X fails LOW, which of the following describes how the Pressurizer Level Control System will respond if no operator action is taken?

a. PRESSURIZER LEVEL HI-LO CHANNEL X annunciator alarms and all standby charging pumps start.

b. Letdown flow decreases to minimum flow and both standby charging pumps start.

c. All pressurizer heaters deenergize and the PRESSURIZER LEVEL LO-LO annunciator alarms.

d. Only PRESSURIZER LEVEL LO-LO annunciator alarms.

QUESTION: 044 (1.00)

Pressurizer Level Indication at the Auxiliary Shutdown Panel AI-185 is pegged low. Which ONE of the following conditions is required to cause this indication?

a. Level transmitter LT-101X fails low.

b. Level transmitter LT-101Y fails low.

c. Both level transmitters LT-101X AND LT-101Y must fail low.

d. Either level transmitter LT-101Y OR LT-101X fails low with the Channel Selector Switch in the X position.

QUESTION: 045 (1.00)

Key lock switch HC-102-1 for Power Operated Relief Valve [PCV-102-1] has been taken to the OPEN position on CB-1/2/3 and the RED indicating light is ON. Which ONE of the following describes how the indicating light circuit is activated?

a. Movement of the solenoid plunger actuates a limit switch.

b. Movement of the pilot valve lever actuates a limit switch.

c. Contacts in the key lock switch actuate the indicating circuit.

d. Acoustic monitors sense flow noise and actuate the indicating circuit.

QUESTION: 046 (1.00)

MULTIPLE CHOICE:

After evacuation of the Control Room, a handswitch on MCC-4C1 can be used to energize backup heater ____(1)____ provided the switch on Alternate Shutdown Panel AI-185 is in the ____(2)____ position.

a. (1) Bank No.1 (2) Local

b. (1) Bank No.1 (2) Remote

c. (1) Bank No.4 (2) Remote

d. (1) Bank No.4 (2) Local

QUESTION: 047 (1.00)

If the manual trip pushbutton on CB-4 is the only trip pushbutton actuated, which of the following describes the response of the Reactor Protective System?

a. Opens contacts in the M coil circuit causing two of four RPS breakers to trip on undervoltage.

b. Opens contacts in the M coil circuit causing all four RPS breakers to trip on undervoltage.

c. Opens contacts in the M coil circuit causing all four clutch power supplies to deenergize.

d. Contacts in the RPS breakers undervoltage trip circuits open and trip all four RPS breakers.

QUESTION: 048 (1.00)

Which of the following Engineered Safeguards signals will automatically close Hydrogen Purge Dampers HCV-881 and HCV-882?

a. Ventilation Isolation Actuation Signal [VIAS].

b. Pressurizer Pressure Low Signal [PPLS].

c. Containment Spray Actuation Signal [CSAS].

d. Containment Radiation High Signal [CRHS].

QUESTION: 049 (1.00)

Which of the following describes the operation of the Spent Fuel Pool Cooling System [SFPCS]?

a. SFPCS pumps can be started and stopped locally or in the Control Room, but demineralizer and filter flow can only be read in the Control Room.

b. SFPCS pumps can be started and stopped locally or in the Control Room, but demineralizer and filter flow can only be read locally.

c. SFPCS pumps can only be started and stopped locally and demineralizer and filter flow can only be read locally.

d. SFPCS pumps can only be started and stopped locally, but demineralizer and filter flow can only be read in the Control Room.

QUESTION: 050 (1.00)

Which ONE of the following shutdown signals remain enabled during an emergency start of the Emergency Diesel Generator?

a. Engine overspeed

b. High water temperature

c. Low lube oil pressure

d. High crankcase pressure

QUESTION: 051 (1.00)

Which of the following describes parallel operation of the Emergency Diesel Generators [EDG]?

a. Either EDG may be operated in parallel with the power source which is supplying its respective 1A3 or 1A4 bus.

b. The EDGs can operate in parallel only when buses 1A3 and 1A4 are connected by the cross tie breaker.

c. Interlocks prevent parallel operation of EDG-1 and EDG-2 when connected to their respective 1A3 and 1A4 buses.

d. Only Operating Procedures prevent parallel operation of the EDGs through the 480V buses.

QUESTION: 052 (1.00)

If a spurious trip signal causes the normal supply breaker for safeguards bus 1A3 to open, which of the following is the first action that occurs to restore power to the safeguards bus?

a. EDG-1 emergency starts and loads onto the bus.

b. The normal supply breaker performs an automatic reclose after 0.5 seconds.

c. The cross tie breaker between safeguard buses 1A3 and 1A4 automatically closes.

d. A fast transfer to the alternate power supply for bus 1A3 occurs.

QUESTION: 053 (1.00)

Battery Charger #1 has failed and the #1 DC bus has been stripped of unnecessary loads. Based on these conditions, the batteries are rated to provide DC power for which of the following periods?

a. 6 hours

b. 8 hours

c. 10 hours

d. 12 hours

QUESTION: 054 (1.00)

MULTIPLE CHOICE

The Main Steam Isolation Valve [MSIV] disk is held in the open position by ____(1)____ pressure acting against ____(2)____ pressure trying to close the valve.

a. (1) hydraulic (2) spring

b. (1) hydraulic (2) steam

c. (1) pneumatic (2) spring

d. (1) spring (2) steam

QUESTION: 055 (1.00)

The Jockey Pump used to pressurize the fire main is supplied with water from which of the following sources?

a. Raw water system

b. Potable water system

c. Screen wash system

d. Intake structure bays

QUESTION: 056 (1.00)

Which of the following is the automatic action that occurs when Instrument Air pressure decreases to 80 psig?

a. Service Air Header Isolation Valve PCV-1753 closes.

b. Receivers "A" and "B" align to supply the Instrument Air Header.

c. Bypass valve PCV-1752 opens to bypass the air dryers.

d. The third Service Air Compressor receives a start signal.

QUESTION: 057 (1.00)

Shutdown cooling has been in operation for the past 8 hours when shutdown cooling flow as read on FIC-326 decreases to 900 gpm. Which ONE of the following describes the plant response to this condition?

a. SDHX Bypass Valve [FCV-326] goes to the closed position.

b. SDHX Bypass Valve [FCV-326] goes to the full open position.

c. Hot Leg Suction Valves [HCV-347 and 348] go to the closed position.

d. SHUTDOWN COOLING FLOW LOW alarm is the ONLY plant response actuated.

QUESTION: 058 (1.00)

Which one of the below is the MINIMUM RCS makeup rate that is sufficient to replenish the boil off from decay heat following a loss of shutdown cooling?

a. 15 gpm

b. 55 gpm

c. 1500 gpm

d. 5500 gpm

QUESTION: 059 (1.00)

Given the following Quench Tank conditions:

- Quench Tank Pressure --- 9 psig
- Quench Tank Temperature --- 118 degrees F
- Quench Tank Level --- 45%

Which ONE of the following actions should be taken to restore normal operating conditions in the Quench Tank in accordance with OI-RC-6, "Pressurizer Quench Tank Normal Operation?"

a. Raise Nitrogen pressure.

b. Vent the Quench Tank to the Vent Header.

c. Add Demineralized Water while draining to the RCDT.

d. Add Demineralized Water while venting to the Vent Header.

QUESTION: 060 (1.00)

If a Component Cooling Water/Raw Water [CCW/RW] interface valve is NOT handjacked shut, which ONE of the following would cause this valve to open?

a. Primary solenoid energizes; secondary solenoid energizes.

b. Primary solenoid de-energizes; secondary solenoid de-energizes.

c. Primary solenoid de-energizes; secondary solenoid energizes.

d. Primary solenoid energizes; secondary solenoid de-energizes.

QUESTION: 061 (1.00)

Which of the following can be placed in a throttled position from the Control Room?

a. CCW supply to SI and CS pumps, HCV-474.

b. Storage Pool Heat Exchanger Outlet Valve, HCV-478.

c. CEDM seal coolers outlet valve, HCV-2859.

d. CCW Heat Exchanger AC-1A Outlet Valve, HCV-489B.

QUESTION: 062 (1.00)

If one Raw Water Pump is operating and a rupture develops at the discharge of the pump, which of the following describes the effect on pump operation?

a. Total dynamic head decreases and flow increases.

b. Total dynamic head increases and flow increases.

c. Total dynamic head decreases and flow decreases.

d. Total dynamic head increases and flow decreases.

QUESTION: 063 (1.00)

Which ONE of the following applies to the Turbine Bypass Valve and is NOT applicable to the Atmospheric Steam Dump Valve?

a. Capable of passing 5% steam flow.

b. Control Room indicator displays the percent full open signal applied to the actuator.

c. Capable of being operated remotely.

d. Capable of being operated in manual or automatic.

QUESTION: 064 (1.00)

Which one of the following describes the automatic action associated with the Compressed/Instrument Air Systems?

a. Containment IA Isolation Valves [PCV-1849A & B] close when upstream air pressure decreases to 70 psig.

b. Standby Air Compressor starts when SA system pressure decreases to 94 psig.

c. The Third Air Compressor starts when SA system pressure decreases to 87 psig.

d. Service Air Containment Isolation Valve [PCV-1749] closes if SA pressure in containment decreases to 70 psig.

QUESTION: 065 (1.00)

After an Auxiliary Feed Actuation Signal (AFAS), the AFW flow control valve, HCV-1107B, can be throttled from the hand controller on CB-10 only if the four-position switch on AI-66B is selected to:

a. AUTO

b. RESET

c. CLOSE

d. OPEN

QUESTION: 066 (1.00)

The following plant conditions exist:

- A steam line break exists upstream of Main Steam Isolation Valve, HCV-1041A.
- SGIS has automatically initiated.

Which one of the following conditions will result from a failure to establish a steaming flowpath from steam generator RC-2B prior to dryout of steam generator RC-2A?

a. An increase in the core exit temperatures resulting in an interruption of natural circulation.

b. An inability to open HCV-1042B due to pressure difference created when affected steam generator reaches dryout conditions.

c. A rapid decrease in T-cold of the unaffected loop resulting in an interruption of natural circulation.

d. A rapid repressurization of the RCS and subsequent Pressurized Thermal Shock (PTS) conditions.

QUESTION: 067 (1.00)

The following plant conditions exist:

- A reactor trip has occurred from 100% power.
- Reactor power is decreasing; startup rate is negative.
- Two Regulating CEAs have NOT fully inserted into the core.
- Reactor operators are performing Instruction 1 of EOP-00, "VERIFY Reactivity Control".

Which one of the following operator actions is the FIRST to be performed for this situation?

a. CONTINUE on to Instruction 2 of EOP-00 (Standard Post Trip Actions).

b. CLOSE FCV-269 (Makeup Water Control Valve).

c. START all available charging pumps.

d. CLOSE LCV-218-3 (Charging Pump Suction from SIRWT).

QUESTION: 068 (1.00)

If an uncontrolled heat extraction event is occurring due to a steam line break downstream of the main steam isolation valves (MSIVs), which one of the following conditions resulting from the event will terminate the heat extraction without operator action?

a. RCS pressure decreases to 1455 psig.

b. Containment pressure increases to 3.5 psig.

c. Steam generator pressures decrease to 484 and 485 psig.

d. Steam generator levels decrease to 31 and 32 inches wide range.

QUESTION: 069 (1.00)

During a fuel handling accident in the containment, the Control Room operator notices the following conditions:

- Containment filtering units are isolated.
- Control Room ventilation is in the Normal Mode.
- A radwaste gas release is in progress.

Which one of the following is the most effective/expedient response to these fuel handling accident conditions?

a. Manually initiate CIAS.

b. Manually initiate VIAS.

c. Terminate waste gas release.

d. Transfer control room ventilation to RECIRC Mode.

QUESTION: 070 (1.00)

Which one of the following combinations correctly completes the following statement?

The presence of a(an) __(1)__ alarm, along with __(2)__, indicates a possible liquid radwaste release above release permit limits via the normal release path.

a. (1) Waste Disposal System Malfunction; (2) HCV-691 open and pump WD-23A running

b. (1) Area Radiation Trouble; (2) HCV-692 open and pump WD-23B running

c. (1) Panel AI-33C Radiation Monitor Trouble; (2) HCV-692 open and pump WD-23A running

d. (1) Process Radiation High or Trouble; (2) HCV-691 open and pump WD-23B running

QUESTION: 071 (1.00)

With the plant at 80% power, which one of the following indicates a condition requiring emergency boration according to AOP-3 (Emergency Boration)?

a. T-cold is decreasing; HCV-1040 (Atmosphere Steam Dump) won't close

b. Loss of Primary CEA Position Indication system

c. Receipt of a ROD POSITION DEVIATION LOW-LOW LIMIT alarm

d. Group 4 CEAs 15 inches below power dependent insertion limit

QUESTION: 072 (1.00)

Which one of the following process radiation monitors, if alarming, will NOT cause a PROCESS RADIATION HIGH OR TROUBLE alarm?

a. Condenser Off-gas (RM-057)

b. Containment Air Particulate (RM-050)

c. Component Cooling Water (RM-053)

d. Waste Disposal Liquid Effluent (RM-055A)

QUESTION: 073 (1.00)

Given the following plant conditions with a leaking pressurizer PORV:

- Pressurizer pressure 1200 psia
- Quench tank pressure 5 psig
- Quench tank temperature 90 F.
- Reactor is shutdown

Assume ambient heat losses are negligible and the quality of the steam in the pressurizer steam space is 100%.

Which one of the following PORV downstream temperatures would result from the leaking pressurizer PORV?

a. 228 F

b. 258 F

c. 288 F

d. 318 F

QUESTION: 074 (2.00)

The reactor is operating at full power conditions when a complete loss of instrument air header pressure occurs. Match each valve in Column A with the IMMEDIATE position/condition in Column B caused by the loss of air pressure. (0.5 each)

(Numbers from column B may be used once, more than once, or not at all, but only a single answer may occupy each answer space.)

Column A (COMPONENT)	Column B (CONDITION/POSITION)
____ a. AFW Containment Isolation valves (HCV-1107A/8A)	1. Fail as is/f[illegible] cannot chang
____ b. CCW to RCP Seal & Lube Oil Coolers (HCV-438B)	2. Fail closed/[illegible]w stopped
____ c. Letdown Flow Control Valves (LCV-101-1/2)	3. Fail open/flow maximum
____ d. RCP Controlled Bleed-Off to VCT (HCV-241)	4. No immediate effect/system functions normally

QUESTION: 075 (1.00)

Which one of the following events is c[illegible]red by AOP-8 (Fuel Handling Incident)?

a. A new fuel assembly is dropped while being loaded into the fuel elevator.

b. The reactor goes critical while an irradiated fuel assembly is being reloaded into the core.

c. A spent fuel assembly is damaged while being inserted into the spent fuel pool rack.

d. Water level in the refueling cavity starts dropping rapidly during refueling operations.

QUESTION: 076 (2.00)

The unit is operating at full power. Match each of the following RCP seal pressure (psia) conditions in column A to the applicable seal status in column B. (0.5 each)

(Numbers in column B may be used once, more than once, or not at all, but only a single answer may occupy each answer space.)

Column A
(PRESSURE CONDITIONS - PSIA)

	RCS	MIDDLE SEAL	UPPER SEAL	VCT
_____ a.	2100	2050	2000	50
_____ b.	2100	2080	1050	40
_____ c.	2100	1050	50	48
_____ d.	2100	1060	1030	45

Column B
(SEAL STATUS)

1. Normal
2. Lower Seal Failure
3. Middle Seal Failure
4. Upper Seal Failure
5. Lower and Middle Seal Failure
6. Middle and Upper Seal Failure

QUESTION: 077 (1.00)

Given the following plant conditions:

- Small break LOCA has occurred
- Pressurizer pressure is stable at 1400 psia
- Containment temperature is 187 F
- Actual pressurizer level is 50%

Select the combination below that fills in the following blanks.

The low pressurizer pressure tends to make the indicated pressurizer level __(1)__ than actual; the high containment temperature tends to make the indicated pressurizer level __(2)__ than actual.

a. (1) Lower; (2) Lower

b. (1) Lower; (2) Higher

c. (1) Higher; (2) Lower

d. (1) Higher; (2) Higher

QUESTION: 078 (1.00)

Conditions have occurred such that the 13.8KV/480V transformer must supply 480V Bus 1B3C. Which of the following states the actions necessary to connect the 13.8KV source to 480V Bus 1B3C using breaker 1B3C-4?

a. Lockout relay 86/1B3C must be reset and Bus 1B3C must be stripped of all loads before breaker 1B3C-4 can be closed.

b. Normal supply breaker 1B-3C to Bus 1B3C must be opened and breaker 1B3C-4 must be closed.

c. Normal supply breaker 1B-3C to Bus 1B3C must be opened and racked out before breaker 1B3C-4 can be closed.

d. Lockout relay 86/1B3C must be reset for the autoclosure circuit to close breaker 1B3C-4 when no voltage is sensed on Bus 1B3C.

QUESTION: 079 (1.00)

Which of the following statements is correct concerning the relative value of the Shutdown Margin (SDM) after a reactor trip from 1% equilibrium power versus from 100% equilibrium power?

(Assume pre-trip CEA positions are the same for both cases, and NO post-trip operator actions are taken which would affect SDM.)

a. The greater SDM would exist after the 1% power trip

b. The greater SDM would exist after the 100% power trip

c. The SDM would be the same for both trips

d. After 72 hours (Xenon-free) both SDMs would be the same

QUESTION: 080 (1.00)

If RCS pressure drops below steam generator pressure during a loss of coolant accident, it indicates that:

a. The ECCS flow is inadequate to remove decay heat.

b. The main steam isolation valves have been closed.

c. The break flow is removing all core decay heat.

d. Heat removal by reflux boiling is taking place.

QUESTION: 081 (1.00)

Which one of the following describes the consequences of late initiation of once-through core cooling during conditions where it is required?

a. The flow rate through the PORVs may no longer be adequate to remove decay heat, which may lead to core damage

b. The decay heat level may not be adequate to support sufficient natural circulation flow to prevent core damage

c. The HPSI flow rate may no longer be adequate to maintain RCS inventory high enough to prevent core damage

d. The increase in RCS temperatures may increase hydraulic forces on the fuel assemblies, which may lead to core damage

QUESTION: 082 (1.00)

Which one of the following RCS pressure-temperature combinations would require the tripping of all RCPs following a reactor trip?

A copy of EOP Attachment 2 is provided for reference.

	Pressure	CET Avg	T-hot	T-cold
a.	900 psia	510 F	505 F	495 F
b.	800 psia	485 F	480 F	480 F
c.	700 psia	480 F	485 F	480 F
d.	600 psia	455 F	445 F	445 F

QUESTION: 083 (1.00)

Which of the following states the RCS pressure at which one RCP in each loop should be tripped during the performance of EOP-00 (Standard Post-Trip Actions), and the location of the small-break LOCA for which this RCP trip strategy is designed?

a. 1350 psia; cold leg

b. 1350 psia; hot leg

c. 1600 psia; cold leg

d. 1600 psia; hot leg

QUESTION: 084 (1.00)

The plant is initially at 60% power and no operator actions are in progress. The control room operators note that the indicated ASI value is moving in the negative direction. Which of the following is the most probable cause of the ASI change?

a. A steam generator safety valve popping open

b. A dropped shutdown group CEA

c. An unplanned RCS boron dilution

d. An uncontrolled CEA withdrawal

QUESTION: 085 (1.00)

In the hierarchy of Critical Safety Functions (CSFs), which CSF ranks directly behind Reactivity Control in the priority order?

a. RCS Inventory

b. RCS Pressure Control

c. Containment Isolation

d. Maintenance of Vital Auxiliaries

QUESTION: 086 (1.00)

Which of the following describes the automatic action(s) that result(s) from a HIGH ACTIVITY alarm on RM-057 (Condenser Off-Gas)?

a. Off-gas diverts through VA-82 (Containment H2 Purge Filter), AND RCV-978 (6th stage extraction to Aux Steam) closes.

b. Off-gas diverts through VA-82 (Containment H2 Purge Filter).

c. RCV-978 (6th stage extraction to Aux Steam) closes.

d. NO automatic action(s) result. ALL required action(s) are MANUAL manipulations.

QUESTION: 087 (1.00)

Which of the following parameter trends is INCONSISTENT with the indications expected for a void in the RCS during natural circulation cooling?

a. RCS pressure is remaining steady near 800 psia while Aux Spray is flowing to the pressurizer.

b. RCS pressure is remaining steady near 800 psia while RVLMS indicates 83% with slowly decreasing pressurizer level.

c. Pressurizer level decreases rapidly from 30% to 5% while the RCS is depressurized with Aux Spray.

d. Pressurizer level increases rapidly from 5% to 30% while Aux Spray is flowing to the pressurizer.

QUESTION: 088 (1.00)

If SG water level drops to 20% (Narrow Range) after a reactor trip, which of the following is the preferred method of feeding that SG with AFW to minimize the possibility of water hammer?

a. Via AFW nozzles using FW-6 full flow

b. Via AFW nozzles at 150 gpm

c. Via Feed Ring using FW-6 full flow

d. Via Feed Ring at 150 gpm

QUESTION: 089 (1.00)

Current plant conditions:

The reactor has been tripped
All RCPs were tripped 30 minutes ago
T-hot is steady at 540 degrees F

Which of the following RCS parameters indicates that inadequate core cooling/inadequate natural circulation flow exists for the above conditions?

a. T-cold is 510 degrees F and steady.

b. T-cold is 505 degrees F and decreasing.

c. CET average is 545 degrees F and steady.

d. Pressure is 1100 psia and decreasing.

QUESTION: 090 (1.00)

Given the following plant conditions:

- 100% reactor power
- Boron concentration = 775 ppm
- CEAs in all groups are fully withdrawn
- Current burnup = 1000 MWD/MTU
- CEA 40 in Group 4 has been determined to be stuck out (NOT trippable).

Which of the following is the Total Instantaneous Shutdown Margin for the conditions given above? (References are provided)

a. + 2.26 %

b. - 4.34 %

c. - 4.78 %

d. - 5.12 %

QUESTION: 091 (1.00)

The reactor has been manually tripped from rated load because of a slow uncontrollable decrease in RCS pressure. Current indications are:

- RCS pressure: 1700 psia and slowly decreasing
- Highest CET: 537 degrees F
- Pressurizer level (LIC-101X): 30% and decreasing
- Pressurizer level (LIC-101Y): 30% and decreasing
- Containment pressure: 1.5 psig and increasing
- Normal containment sump: high level alarm
- Quench tank level: 70% and stable
- Quench tank temperature: 100 degrees F and stable
- Pressurizer heaters: All OFF

What failure could have caused the above events and indications?

a. A pressurizer PORV has failed open

b. A pressurizer spray valve has failed open

c. A pressurizer reference leg has ruptured

d. A pressurizer heater well has ruptured

QUESTION: 092 (2.00)

For each automatic action in column A, select the main condenser vacuum setpoint at which the action should occur from column B. (0.5 each)

(Numbers in column B may be used once, more than once, or not at all, but only a single number may occupy each answer space.)

Column A (AUTOMATIC ACTIONS)	Column B (VACUUM SETPOINTS)
_____a. Turbine Trip	1. 25 inches Hg
_____b. Steam dump and bypass valves disabled	2. 23.85 inches Hg
	3. 21.35 inches Hg
_____c. Standby vacuum pump starts	4. 20.5 inches Hg
_____d. EXHAUST PRESSURE HI alarm	5. 19 inches Hg
	6. 10 inches Hg

QUESTION: 093 (1.00)

What is the reason flow through each operating HPSI pump must be at least 50 gpm after an RAS?

a. To maximize heat removal by the coolant break flow

b. To maximize the chemical mixing in the containment sump

c. To minimize the possibility of HPSI pump overheating

d. To minimize the damage done by HPSI pump cavitation

QUESTION: 094 (1.00)

With the plant operating at 100% power and pressurizer level control channel X selected, the output signal from Loop 1 Hot Leg control channel RTD (TE-111) fails LOW. Which of the following combinations indicates the resultant plant response with no operator actions?

	LETDOWN FLOW	B/U HEATERS	B/U CHARGING PUMP
a.	Increases	Deenergize	Starts
b.	Increases	Energize	Stops
c.	Decreases	Deenergize	Starts
d.	Decreases	Energize	Stops

QUESTION: 095 (1.00)

During accident recovery operations, the operators attempt to maintain the RCS subcooling margin (SCM) within minimum and maximum limits.

a. The minimum SCM required for HPSI pump stop and throttle operations is _____ degrees F. (0.5)

b. The maximum SCM allowed for pressurized thermal shock considerations is _____ degrees F. (0.5)

QUESTION: 096 (1.00)

Which of the following states the EOP-3 recovery actions required specifically for a LOCA outside containment (interfacing system LOCA) that has occurred while the plant was operating at full power?

a. Isolate letdown, RCS sampling, and shutdown cooling.

b. Initiate RAS in advance of STLS to conserve SIRWT inventory.

c. Drain all SI Tanks to RC Drain Tank to reduce tank pressures to less than 100 psig.

d. Use Atmospheric Dump Valve instead of Turbine Bypass Valves for plant cooldown.

QUESTION: 097 (1.00)

If two (2) power range safety channels become erratic while the reactor is at 80% power, and a reactor trip does NOT occur, which of the following is required? (Other power range safety channels are operating properly.)

a. Manually trip the reactor and enter EOP-00.

b. Within an hour place associated trip units (TUs) on one affected channel in bypass and associated TUs on the other channel in the tripped position; reduce power to 70% or less.

c. Within an hour reduce power to less than or equal to 15% and then trip the reactor and enter EOP-00.

d. Within an hour place associated trip units on both of the affected channels in bypass; reduce power to 70% or less.

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

ANSWER: 001 (1.00)

b.

REFERENCE:

10 CFR 20, para. 20.101
Both
[2.8/3.4]

194001K103 ..(KA's)

ANSWER: 002 (1.00)

b.

REFERENCE:

Fort Calhoun Station S.O. G-52-2
Both
[2.5/3.4]

194001A103 ..(KA's)

ANSWER: 003 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: Lesson Plan 7-53-2, p.7
SRO Only
[3.1/3.4]

194001A115 ..(KA's)

ANSWER: 004 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-G-28, p.7 of 141
Both
[3.5/4.2]

194001K116 ..(KA's)

ANSWER: 005 (1.00)

d.

REFERENCE:

10CFR55.13.a.2; SO-O-1, p. 38

194001A111 ..(KA's)

ANSWER: 006 (1.00)

c.

REFERENCE:

10CFR55.53e

194001A103 ..(KA's)

ANSWER: 007 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-O-22, p.1 of 3
Radiation Protection Procedure RP-213, p.2 of 6
Both
[3.1/3.4]

194001K105 ..(KA'

ANSWER: 008 (1.00)

d

REFERENCE:

Fort Calhoun Station SO-0-1, p.85 of 97
Both
[2.7/3.9]

194001K109 ..(KA's)

ANSWER: 009 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-0-1, p.58, 59, 60, 61
Both
[2.5/3.4]

194001A103 ..(KA's)

ANSWER: 010 (1.00)

d.

REFERENCE:

Fort Calhoun Station SO-01, p.81
Both
[3.4/3.4]

194001A106 . (KA's)

ANSWER: 011 (1.00)

b.

REFERENCE:

Fort Calhoun Station SO-O-20, p.5
Both
[3.6/3.7]

194001K101 ..(KA's)

ANSWER: 012 (1.00)

d.

REFERENCE:

Fort Calhoun Station SO-O-1, p.73
RO only
[3.0/3.2]

194001A104 ..(KA's)

ANSWER: 013 (1.00)

a.

REFERENCE.

Fort Calhoun Station SO-G-7, p.4, 5, 6
RO only
[3.3/3.4]

194001A101 ..(KA's)

ANSWER: 014 (1.00)

d.

REFERENCE:

Technical Specifications p. 6 [Definitions]
Both
[2.8/3.4]

001000K553 ..(KA's)

ANSWER: 015 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-12-26, p.36
Question Bank 1-7-26,1.8 003
Both
[2.8/3.3]

001000K602 ..(KA's)

ANSWER: 016 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-11-20, p.32
Both
[3.6/3.6]

003000A304 ..(KA's)

ANSWER: 017 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-11-20, p.89 & 90
Both
[2.7/3.1]

003000K602 ..(KA's)

ANSWER: 018 (1.00)

c.

REFERENCE:

Systems Training Manual CVCS, p.11
Both
[3.4/3.1]

004020A303 ..(KA's)

ANSWER: 019 (1.00)

d.

REFERENCE:

Systems Training Manual CVCS, p.25
Both
[3.4/3.7]

004000K123 ..(KA's)

ANSWER: 020 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-12-14, p. 37
Both
[3.6/3.8]

013000K108 ..(KA's)

ANSWER: 021 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-12-14, p.24
RO only
[4.5/4.7]

013000A403 ..(KA's)

ANSWER: 022 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-12-19, p.33
Both
[3.1/3.2]

015000K604 ..(KA's)

ANSWER: 023 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-12-18, p.51
Exam Bank 1-7-12-18,1.13 001
RO only
[3.9/4.0]

015000K403 ..(KA's)

ANSWER: 024 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-12-20, p.8
Both
[3.1/3.3]

017020K403 ..(KA's)

ANSWER: 025 (1.00)

c.

REFERENCE:

System Training Manual - Containment, p.23, 29
Both
[3.3/3.5]

022000G007 ..(KA's)

ANSWER: 026 (1.00)

a.

REFERENCE:

System Training Manual - Containment, p.19, 29
RO only
[3.2/3.3]

022000A104 ..(KA's)

ANSWER: 027 (1.00)

a.

REFERENCE:

Systems Training Manual --- CF, p.43, 44
Both
[2.6/2.6]

056000K103 ..(KA's)

ANSWER: 028 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-11-11. p.15
Exam Bank 1-7-11-11,1.2 001
Both
[3.1/3.1]

059000G009 ..(KA's)

ANSWER: 029 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-1[illegible]-11, p.21
Systems Training Manual --- CF, p.32
RO only
[2.5/2.6]

059000A303 ..(KA's)

ANSWER: 030 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-1[illegible]-1. p.54
Both
[2.5/2.8]

061000K501 ..(KA's)

ANSWER: 031 (1.00)

a.

REFERENCE:

Procedure OI-WDL-3, p.7 of 35
Both
[3.6/3.6]

068000A302 ..(KA's)

ANSWER: 032 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-12-3, p.55
Both
[2.5/2.8]

071000G007 ..(KA's)

ANSWER: 033 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-12-3, p.27
Both
[3.6/4.2]

073000K301 ..(KA's)

ANSWER: 034 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: p.12, 13
Both
[2.7/3.0]

072000K501 ..(KA's)

ANSWER: 035 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-11-1, p.48, 52
RO only
[2.7/3.2]

061000K505 ..(KA's)

ANSWER: 036 (1.00)

b.

REFERENCE:

System Training Manual ---CRD, p.6
Fort Calhoun Station IHB: p.17
RO only
[3.2/3.4]

001000K408 ..(KA's)

ANSWER: 037 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-11-2, p.16, 17
Systems Training Manual ---CVCS, p.57
RO only
[3.6/3.1]

004010A402 ..(KA's)

ANSWER: 038 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-11-22, p. 63
RO only
[3.7/4.1]

026000K404 ..(KA's)

ANSWER: 039 (1.00)

b.

REFERENCE:

Systems Training Manual --- CRD, p.17
RO only
[3.2/3.6]

014000A102 ..(KA's)

ANSWER: 040 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-11-20, p.110, 111
Both
[2.9/3.2]

002000K403 ..(KA's)

ANSWER: 041 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-13-2, p.7
Fort Calhoun Station IHB: 7-11-22, p.25
Both
[3.6/3.9]

006000K201 ..(KA's)

ANSWER: 042 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-11-22, p.26, 27
Both
[3.6/3.9]

006000K603 ..(KA's)

ANSWER: 043 (1.00)

c.

REFERENCE:

Systems Training Manual --- RCS, p.37
Both
[3.4/3.6]

011000A211 ..(KA's)

ANSWER: 044 (1.00)

b.

REFERENCE:

Systems Training Manual ---RCS, p.32
RO only
[3.0/3.3]

011000K404 ..(KA's)

ANSWER: 045 (1.00)

a.

REFERENCE:

Systems Training Manual --- RCS, p.48
Both
[4.0/3.8]

010000A403 ..(KA's)

ANSWER: 046 (1.00)

d.

REFERENCE:

Systems Training Manual ---RCS, p.45
RO only
[3.0/3.4]

010000K201 ..(KA's)

ANSWER: 047 (1.00)

c.

REFERENCE:

Systems Training Manual ---RP, p.26,27
Both
[4.5/4.5]

012000K401 ..(KA's)

ANSWER: 048 (1.00)

b.

REFERENCE:

Fort Calhoun Station TPT: 7-1 , p.11
Both
[3.6/3.8]

029000K103 ..(KA's)

ANSWER: 049 (1.00)

d.

REFERENCE:

Systems Training Manual --- SFC, p.7
Both
[2.5/2.6]

033000G009 ..(KA's)

ANSWER: 050 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-13-5, p. 44, 53
RO only
[3.9/4.2]

064000K402 ..(KA's)

ANSWER: 051 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-13-5, p.9, 10
STM --EDG, p.33
Both
[3.4/3.6]

064000G010 ..(KA's)

ANSWER: 052 (1.00)

d.

REFERENCE:

Systems Training Manual ---ED, p.15 and 38
Both
[3.7/4.2]

062000K104 ..(KA's)

ANSWER: 053 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-13-4, p.10, 11
RO only
[3.0/3.6]

063000G005 ..(KA's)

ANSWER: 054 (1.00)

c.

REFERENCE:

Systems Training Manual --- MS, p.22
Both
[3.2/3.6]

035010K601 ..(KA's)

ANSWER: 055 (1.00)

b.

REFERENCE:

Systems Training Manual --- FP, p.5
Both
[3.0/3.4]

086000K402 ..(KA's)

ANSWER: 056 (1.00)

a.

REFERENCE:

Systems Training Manual --- CIA, p.p. 6 & p.9
Both
[3.0/3.1]

079000K101 ..(KA's)

ANSWER: 057 (1.00)

b.

REFERENCE:

System Training Manual, ECC, p.22
Both
[3.2/3.5]

005000K407 ..(KA's)

ANSWER: 058 (1.00)

~~a.~~ b.

REFERENCE:

AOP-19, p. 3
RO only

005000K301 ..(KA's)

ANSWER: 059 (1.00)

d.

REFERENCE:

Systems Training Manual, RCS, p.53
Procedure OI-RC-6
Both
[2.9/3.1]

007000A101 ..(KA's)

ANSWER: 060 (1.00)

b.

REFERENCE:

Fort Calhoun Station IPB: 7-11-6, p.26, 27
Both
[3.3/3.1]

008000A401 ..(KA's)

ANSWER: 061 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-11-6, p.22, 29, 49, 50
RO only
[2.8/2.9]

008000A101 ..(KA's)

ANSWER: 062 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-11-19, p.9
Both
[2.7/3.1]

076000A202 ..(KA s)

ANSWER: 063 (1.00)

d.

REFERENCE:

System Training Manual MS, p. 28,29
Fort Calhoun Station INB: 7-11-17, p.31 & 34
RO only
[3.0/3.1]

041020A408 ..(KA's)

ANSWER: 064 (1.00)

b.

REFERENCE:

System Training Manual CIA, p.13 through 16
RO only
[2.7/2.9]

078000K401 ..(KA's)

ANSWER: 065 (1.00)

c.

REFERENCE:

FCS Exam Bk 7-11-1,0.0 001
(4.5/4.4)

000054A101 ..(KA's)

ANSWER: 066 (1.00)

d.

REFERENCE:

1. EOP-05, "Uncontrolled Heat Extraction", page 14.
2. KA 000040K106 (3.7/3.8).

000040K106 ..(KA's)

ANSWER: 067 (1.00)

b.

REFERENCE:

EOP-00
(3.9/4.3)

000005K306 ..(KA's)

ANSWER: 068 (1.00)

c.

REFERENCE:

FCS LP 7-12-14, p. 68 - 72
(4.6/4.6)

000040A101 ..(KA's)

ANSWER: 069 (1.00)

b.

REFERENCE:

FCS LP 7-17-8, pg. 6, 7
(3.3/3.8)

000036A101 ..(KA's)

ANSWER: 070 (1.00)

d.

REFERENCE:

FCS LP 7-12-3 REV 2, p. 48, 49
FCS P&ID 11405 M-9, OI WDL-3 REV 19
FCS LP 7-11-31 REV 2 p. 32
(3.2/3.5)

000059A204 ..(KA's)

ANSWER: 071 (1.00)

d.

REFERENCE:

FCS AOP-3, LP 7-12-26, TDB FIG II.b.6, OP-10 pg A8-13
(4.1, 4.4)

000024K301 ..(KA's)

ANSWER: 072 (1.00)

b.

REFERENCE:

FCS STM Rad Mon pg 14
(3.1/3.3)

000076A104 ..(KA's)

ANSWER: 073 (1.00)

c.

REFERENCE:

Steam Tables
(3.6, 4.1)

000008K302 ..(KA's)

ANSWER: 074 (2.00)

a. 4
b. 4
c. 2
d. 2

REFERENCE:

FCS LP 7-11-7; AOP-17 ATTACHMENT 1
(2.9, 3.3)

000065A208 ..(KA's)

ANSWER: 075 (1.00)

c.

REFERENCE:

FCS QB 1-7-17-08,1.1,N 001
(3.4, 4.1)

000036A202 ..(KA's)

ANSWER: 075 (2.00)

a. 5
b. 2
c. 4
d. 3

REFERENCE:

FCS 7-11-20 pg 89
(4.0/4.2)

000015A122 ..(KA's)

ANSWER: 077 (1.00)

d.

REFERENCE:

FCS TDB FIG. III.1.c
(3.4, 3.6)

000009K310 ..(KA's)

ANSWER: 078 (1.00)

b.

REFERENCE:

LP 7-13-1 pg 17; EO 1.4; EOP Att 5
(3.9/4.0)

000055G012 ..(KA's)

ANSWER: 079 (1.00)

a.

REFERENCE:

LP 7-15-12; EO 1.4
(3.4/3.8)

000007K102 ..(KA's)

ANSWER: 080 (1.00)

c.

REFERENCE:

LP 7-15-23; EO 1.2
(4.1/4.4)

000011K101 ..(KA's)

ANSWER: 081 (1.00)

c.

REFERENCE:

LP 7-15-28; EO 1.8
(3.9/4.0)

000009K306 ..(KA's)

ANSWER: 082 (1.00)

c.

REFERENCE:

EOP-00, EOP Attach 2
(3.4/3.4)

000015G010 ..(KA's)

ANSWER: 083 (1.00)

b.

REFERENCE:

LP 7-18-10, pg. 27
(4.0/4.6)

000007K301 ..(KA's)

ANSWER: 084 (1.00)

d.

REFERENCE:

AOP-2, Sect IV
(4.4/4.6)

000001A205 ..(KA's)

ANSWER: 085 (1.00)

d.

REFERENCE:

LP-7-18-10
(3.9/4.0)

000055G012 ..(KA's)

ANSWER: 086 (1.00)

c.

REFERENCE:

7-11-5, p. 30
7-12-3, EO 4.1, p. 30
(3.9/4.1)

000038K304 ..(KA's)

ANSWER: 087 (1.00)

c.

REFERENCE:

EOP Attachment 14
(4.0/4.6)

000074A206 ..(KA's)

ANSWER: 088 (1.00)

d.

REFERENCE:

EOP-00
(3.8/4.1)

000054K303 ..(KA's)

AN WER: 089 (1.00)

d.

REFERENCE:

EOP-00; Steam Tables
(4.6/4.9)

000074A201 ..(KA's)

ANSWER: 090 (1.00)

b.

REFERENCE:

TDB
(3.3/4.1)

000005K105 ..(KA's)

ANSWER: 091 (1.00)

d.

REFERENCE:

STM RCS Instrumentation
(3.5/3.8)

000009A202 ..(KA's)

ANSWER: 092 (2.00)

a. 3
b. 3
c. 1
d. 2 (0.5 each)

REFERENCE:

AOP-26, p. 4
(3.9/4.1)

000051A202 ..(KA's)

ANSWER: 093 (1.00)

c.

REFERENCE:

EOP-03, pg. 32, 33
(4.4/4.6)

000011K312 ..(KA's)

ANSWER: 094 (1.00)

b.

REFERENCE:

STM RIRR, pg. 25
(3.3/3.4)

000028A210 ..(KA's)

ANSWER: 095 (1.00)

a. 20
b. 200 (0.5 each)

REFERENCE

LP 7-15-23, pg. 39
(3.9/4.1)

000011A114 ..(KA's)

ANSWER: 096 (1.00)

a.

REFERENCE:

I.P 7-15-23, pg.42: LO 2.9
(3.4/3.7)

000009K312 ..(KA's)

ANSWER: 097 (1.00)

b.

REFERENCE:

ECS Exam Bank Question I-7-17-15, 1.4, N 001
(2.8/3.4)

000033G008 ..(KA's)

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

ANSWER KEY

MULTIPLE CHOICE

001	b
002	b
003	a
004	a
005	d
006	c
007	a
008	d
~~009~~	~~a~~ ✓ deleted per facility Comment
010	d
011	b
012	d
013	a
014	d
015	c
016	a
017	b
018	c
019	d
020	a
021	b
022	b
023	d
024	b
025	c
026	a
027	a
028	d
029	c
030	c
031	a
032	d
033	c
034	b
035	a
036	b
037	d
038	c
039	b
040	d
041	b
042	b
043	c
044	b
045	a

A N S W E R K E Y

046 d

047 c

048 b

049 d

050 a

051 a

052 d

053 b

054 c

055 b

056 a

057 b

058 ~~a~~ b. ✓ changed per facility Comment

059 d

060 b

061 c

062 a

063 d

064 b

065 c

066 d

067 b

068 c

069 b

070 d

071 d

072 b

073 c

074 MATCHING

a 4

b 4

c 2

d 2

MULTIPLE CHOICE

075 c

076 MATCHING

a 5

b 2

c 4

d 3

MULTIPLE CHOICE

077 d

078 b

079 a

080 c

081 c

A N S W E R K E Y

082 c

083 b

084 d

085 d

086 c

087 c

088 d

089 d

090 b

091 d

092 MATCHING

a 3

b 5

c 1

d 2

MULTIPLE CHOICE

093 c

094 b

095 MATCHING

a 20

b 200

MULTIPLE CHOICE

096 a

097 b

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

5.0 REQUIREMENTS

5.1 Plant Staff within the scope of application shall be limited to the following maximum working hours:

5.1.1 An individual shall not be permitted to work more than 16 hours straight (excluding shift turnover time).

5.1.2 An individual shall not be permitted to work more than 16 hours in any 24-hour period, nor more than 24 hours in any 48-hour period, nor more than 72 hours in any seven day period (all excluding shift turnover time).

5.1.3 A break of at least eight hours shall be allowed between work periods (including shift turnover time). A work period is defined as eight (8) or more hours.

5.1.4 Except during extended shutdown periods, the use of overtime shall be considered on an individual basis and not for the entire staff on shift.

5.2 Section 5.1 points out the guidelines to be followed and in the event that special circumstances arise or emergency conditions exist, deviation from these guidelines may become necessary.

5.2.1 If such deviations are necessary only the Manager - Fort Calhoun Station or his designated alternate may approve them.

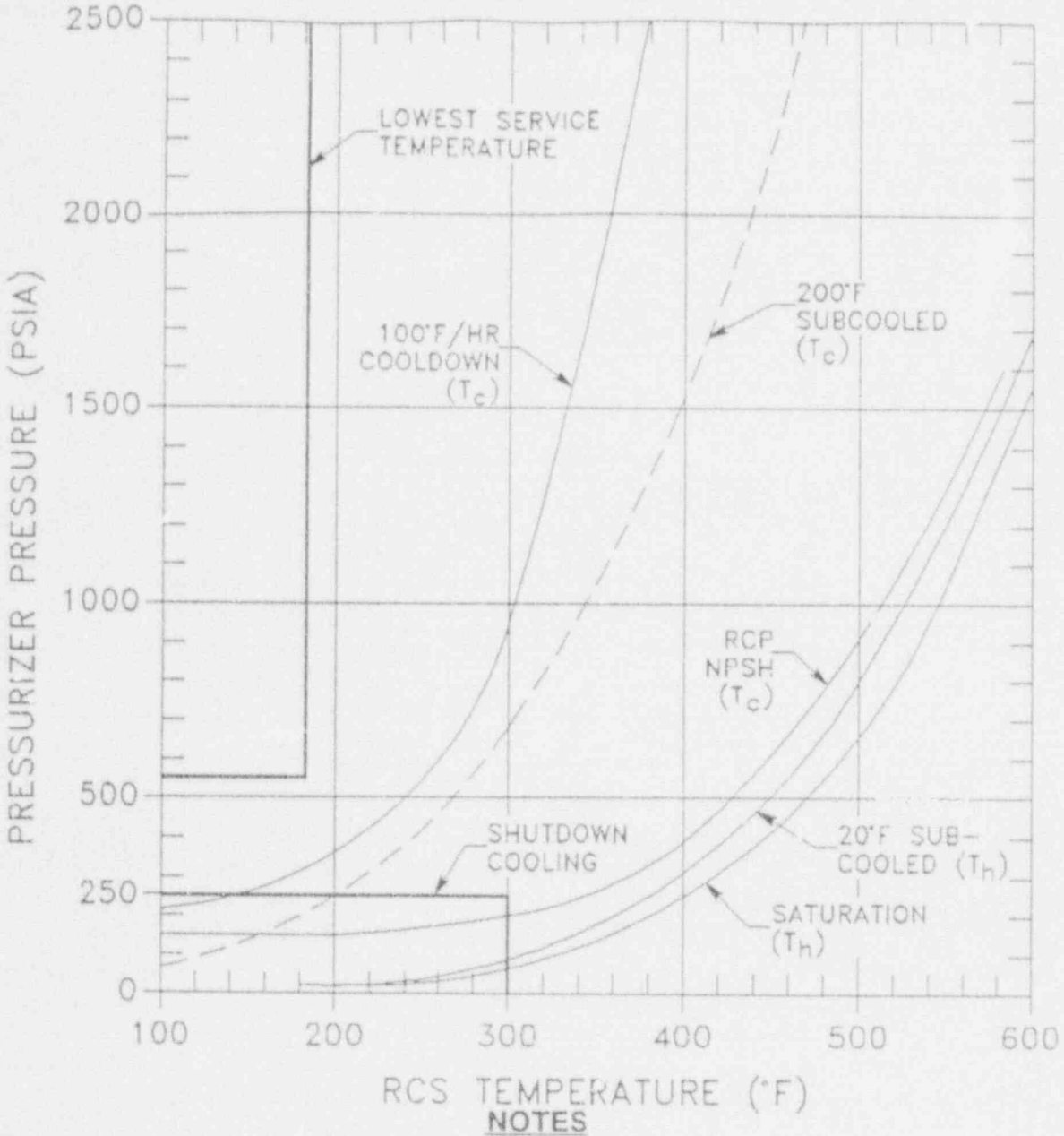
5.2.2 All such deviations shall be documented on a Form FC-70.

ISSUED

JUL 25 1988

ATTACHMENT 2

RCS PRESSURE-TEMPERATURE LIMITS



NOTES

1. This curve is only valid through 14 EFPY.

2. 200°F subcooled curve supersedes 100°/HR cooldown curve anytime RCS has experienced an uncontrolled cooldown causing RCS temperature to go below 500°F.

3. To be the most conservative during forced circulation, T_h, or during natural circulation, CETs should be used for the 20°F subcooled and the saturation curve. T_c should be used for all other curves.

ATTACHMENT 2

RCS PRESSURE-TEMPERATURE LIMITS

RCS TEMPERATURE (°F)	MINIMUM PRESSURE TO MEET RCP NPSH (psia)
82	155
140	155
203	155
240	168
260	178
280	194
300	212
320	239
340	265
359	300
380	351
400	412
425	500
450	600
480	750
500	900
520	1050
540	1200
562	1400
582	1600

Fort Calhoun Station
Unit No. 1

TDB-V.9

TECHNICAL DATA PROCEDURE

Title: SHUTDOWN MARGIN WORKSHEET

Setpoint/Procedure Form Number (FC-68):	38238
Reason for Change:	Correct figure references and make procedure easier to read.
Contact Person:	Keith Voss

SHUTDOWN MARGIN WORKSHEET

PART I - Instantaneous Shutdown Margin for use prior to a Reactor Trip or immediately following a reactor trip. No changes are assumed for xenon, since this worksheet is only applicable for calculation of an instantaneous shutdown margin.

NOTE: Enter values exactly as determined from the figures in the Technical Data Book and carry the algebraic signs through the calculations.

Condition

1. Present Date/Time: _____/_____

2. Reactor Power:
   (before trip) _____%

3. CEA Positions:
   Group 1_____ inches
   Group 2_____ inches
   Group 3_____ inches
   Group 4_____ inches

4. Reactor Coolant System Boron Concentration prior to shutdown: (Boron concentration analysis must have been performed within the past 24 hours or more recently if boration or dilution has occurred.)

   _____ppm

5. Burnup (Take the most recent burnup from the Control Room Log and add approximately 32 mwd/mtu per EFPD.) Determine BOC or EOC.

   _____MWD/MTU

Calculation of Shutdown Margin

6. Enter Regulating Group Worths, based on burnup, see 5, above. (Enter TDB Figure II.B.2.A, B or C and using the CEA positions from 3. above.)

   _____% Δ p
   6.

7. Shutdown Group Worths, based on burnup, see 5. above. (Enter TDB Section II.B.1.a., select correct column.)

   a. Shutdown Group B _____ % Δp

   b. Shutdown Group A _____ % Δp

   c. Total Shutdown Worth (add a. and b. above) _____ % Δp
   7.c.

8. Determine Power Defect

   Use TDB Figure II.C.2.a, b, or c, reactor power (before trip), and burnup 2. and 5. above, to calculate power defect.

   _____ % Δp
   8.

9. Determination of Stuck Rod Allowance (3 cases)

   a. Case I - All rods are assumed to be operable. (No known inoperable rods.)

      Assume the highest worth rod will stick out of the core upon a reactor trip. Enter the value of the most reactive rod, based on burnup, (see 5. above) from TDB Figure II.B.1.b., lines (1) thru (3) for the pre-trip configuration. Select the correct column.

      _____ % Δp
      9.A.

      (Enter N/A if this case is not applicable.)

   b. Case II - One CEA is known to be inoperable (per Tech. Spec. 2.10.2(4) a.)

      Account for this defective CEA (and the highest worth stuck rod) by entering only the value from lines (4) thru (36) of TDB Figure II.B.1.b. for the inoperable rod, based on burnup, (see 5. above). Select the correct column.

      _____ % Δp
      9.B.

      (Enter N/A if this case is not applicable.)

      NOTE: The values of lines (4) thru (36) of TDB Figure II.B.1.b. Include the total reactivity associated with the known inoperable rod and the highest worth rod which is assumed to stick out of the core upon a reactor trip.

c. Case III - More than one CEA is known to be inoperable (per Tech. Spec. 2.10.1.(4) a.).

(Enter n/A if this case is not applicable.)

(1) Enter total number of CEA's which are known to be inoperable per Tech. Spec. 2.10.2 (4) a.

_____ (1)

(2) Enter the worst stuck rod worth from TDB Figure II.B.1.b. lines (1) thru (3) for the pre-trip configuration, based on burnup, (see 5. above). Select the correct column.

_____ % Δρ (2)

(3) Enter the most conservative defective CEA worth from TDB Figure II.B.1.b. Lines (4) thru (36) depending on defective rod(s) location, based on burnup, (see 5. above). Select the correct column.

_____ % Δρ (3)

[(#_____ (1)) - 1] x (_____ (2) % Δρ) + (_____ (3) % Δρ) = _____ c. %Δρ

d. Enter value from 9.A. or 9.B. or 9.C. as appropriate _____ 9.D. % Δρ

10. Calculation of the Total Instantaneous Shutdown Margin: (carry signs)

_____ 9.D. % Δρ + _____ 8. % Δρ - _____ 7.c. % Δρ

-(_____ 6. % Δρ) = _____ 10. TOTAL % Δρ

(CEA's which do not insert) + (power defect) - (total shutdown CEA worth) - (total regulating group worth) = Total instantaneous shutdown margin

11. Calculate difference from required -4.0% Δρ Shutdown Margin.

(_____ 10. % Δρ) + 4.0% Δρ = _____ 11. % Δρ

12. a. If 11. is less than or equal to zero, the shutdown margin is adequate.

b. If 11. is greater than zero, use OI-ERFCS-1, Procedure 36 to determine the number of gallons of acid to add.

NOTE: A -4.0% Δρ shutdown margin must be maintained in a hot shutdown condition, Tc > 210°F (Tech. Spec. 2.10.2 (i)).

PART II - Hot Shutdown Condition (No Rod Movement Planned)

Assumptions: No Xenon, Equilibrium Samarium, All Rods In, T_{AVG} >515F

Conditions		INITIALS/DATE
1. Date/Time:	_____/_____	_____/_____
2. Burnup:	_____MWD/MTU	_____/_____
3. Verify that the Reactor Coolant System Average Temperature is greater than 515 F.		
Record RCS Average Temp	=_____°F	_____/_____
4. Reactor Coolant System Boron Concentration (Boron Analysis must have been performed within the past 24 hours or more recently if boration or dilution has occurred).	_____ppm	_____/_____
5. Verify that all Regulating and Shutdown CEA's are inserted to at least the Lower Electrical Limits (LEL).		_____/_____

Soluble Boron Concentration

6. Calculate the necessary Soluble Boron Concentration change:

   Using core burnup (2.) and TDB Figure II.A.3.b. based upon Group N position, determine the necessary soluble boron concentration.

   _____ppm

7. Compare the Actual Boron Concentration to the Soluble Boron Concentration.

   _____ppm (4.) - _____ppm (6.) = _____ ppm

8. a. If 7. is greater than or equal to zero, the boron concentration is adequate.

   b. If 7. is less than zero, use OI-ERFCS-1, Procedure 36 or manual calculations and borate to the reactor coolant system concentration given in 6.

REMARKS_____

_____

_____

Completed by_____Date/Time_____/_____

PART III - T_{ave} Less Than 515°F

Conditions

INITIALS/DATE

1. Date/Time: _____ ____/____

2. Burnup: _____MWD/MTU ____/____

3. Verify that the Reactor Coolant System Average Temperature (TR-346) or indicated loop temperature is less than 515 F using a. or b. below.

   a. If on shutdown cooling, use

   1/2 * [(_____ + _____)]
   Outlet Suction

   =_____°F

   b. If not on shutdown cooling, then use RCS loop temperature indication for T_{ave}.

   =_____°F ____/____

4. Reactor Coolant System Boron Concentration (Boron Analysis must have been performed within the past 24 hours or more recently if boration or dilution has occurred.) _____ _____ppm ____/____

Soluble Boron Concentration

5. Calculate the necessary Soluble Boron Concentration: Use the applicable TDB Figure II.A.3, based on RCS temperature, 3.a or 3.b, and core burnup, 2, If in Mode 5 enter the refueling Boron Concentration. _____ppm

6. Compare the actual boron concentration to the soluble boron concentration.

   _____ ppm - _____ ppm = _____ ppm
   4 5

7. a. IF 6 is greater than or equal to zero, the boron concentration is adequate.

   b. IF 6 is less than zero, use OI-ERFCS-1, Procedure 36 or manual calculations and borate to the reactor coolant system concentration given in 5.

REMARKS_____

_____

Completed by_____Date/Time_____/_____

PART IV - Use to calculate Shutdown Margin when the Reactor is in a hot or cold shutdown with possible rod movement or Inoperable CEA's, or not at equilibrium xenon

NOTE: Enter values exactly as determined from the figures in the Technical Data Book and carry the algebraic signs through the calculations.

Condition

1. Present Date/Time _____/____

2. Date/Time of Shutdown _____/____

3. Hours elapsed since shutdown _____Hours

4. Reactor power level before shutdown (% of 1500 MWth) _____%

5. Reactor Coolant cold leg temperature: _____°F
Tc

6. Circle appropriate shutdown conditic

Tc ≥ 210°F—> Hot shutdown margin required

Tc < 210°F—> Cold shutdown margin required

7. CEA Positions before shutdown

Regulating Group 1 _____inches

Regulating Group 2 _____inches

Regulating Group 3 _____inches

Regulating Group 4 _____inches

8. Burnup: (Take the most recent burnup from the Control Room Log and add approximately 32 mwd/mtu per EFPD.) Determine BOC or EOC.

_____MWD/MTU

9. Wortn of change in boron concentration

a. Reactor coolant system boron concentration prior to shutdown or trip.

_____ppm
9.a.

b. Inverse boron worth for power level prior to shutdow (using TDB Figure II.A.4. with burnup, 8.)

_____ppm/% Δρ
9.b.

c. Reactive worth for initial boron concentration.

_____ / _____ = _____% Δρ
9.a. 9.b. 9.c.

d. Present reactor coolant boron concentration

_____ppm
9.d.

e. Inverse boron worth for hot zero power (HZP) using TDB Figure II.A.4. with burnup, 8.

_____ppm/% Δρ

f. Reactive worth for present boron concentration.

_____ / _____ = _____% Δρ
9.d. 9.e. 9.f.

g. Change in reactive worth for change in boron concentration.

_____ - _____ = _____% Δρ
9.f. 9.c. 9.g.

Calculation of Shutdown Margin

10. Determine Power Defect

Use TDB Figure II.C.2.a, b, or c, use reactor power (before trip), and burnup 4. and 8. above, to determine power defect.

_____% Δρ
10.

11. Calculate Xenon Reactivity

a. Current Xenon Worth (Use TDB Figure II.D.2. and hours since shutdown 3. above.)

_____% Δρ
11.A.

b. Xenon worth prior to shutdown (Use TDB Figure II.D.1.a and reactor power 4. above.)

_____% Δρ
11.B.

c. Change in Xenon worth due to shutdown.

(_____)% Δρ - (_____)% Δρ = (_____)% Δρ
11.b 11.a 11.c

12. Total Rod Worth

a. Regulating group worth based on burnup, See 8. above.

(Use TDB Figure II.B.2.a, b or c and CEA positions from 7. above.)

_____% Δρ
12.a.

b. Shutdown Group B worth based on burnup, see 8. above.

(Use TDB Section II.B.1.a. Select correct column.)

_____% Δρ
12.b.

c. Shutdown Group A worth based on burnup, see 8. above.

(Use TDB Section II.B.1.a. Select correct column.)

_____% Δρ
12.c.

d. Total rod worth

(Add 12.a., b. and c. above) _____% Δρ
12.c.

13. a. Enter rod positions if group rod withdrawal is required. (Enter N/A if not applicable.)

Shutdown Group A	_____	inches
Shutdown Group B	_____	inches
Regulating Group 1	_____	inches
Regulating Group 2	_____	inches
Regulating Group 3	_____	inches
Regulating Group 4	_____	inches

b. Enter the position if an individual rod is to be withdrawn.

Individual Rod Group _____ Rod Number_____

Inches withdrawn _____

(Enter N/A if not applicable.)

14. Reactivity for group or individual rod withdrawals:

(Enter N/A if not applicable.)

a. If shutdown Group A is withdrawn (Use TDB Figure II.B.1.A. and burnup, see 8. above. Select correct column.)

_____% Δρ
14.A.

b. If shutdown Group B is withdrawn (Use TDB Figure II.B.1.A. and burnup, see 8. above. Select correct column.)

_____% Δρ
14.B.

c. If regulating groups are withdrawn sequentially (Use TDB Figure II.B.2.a, b or c, and CEA positions from 13. above.) Based on burnup. See 8. above.

_____% Δρ
14.C.

d. If an individual regulating rod or shutdown rod is withdrawn, consult the Reactor Engineer to calculate its reactivity.

_____% Δρ
14.D.

e. Total rod withdrawal reactivities

Add 14.a., b., c. and d., as applicable.

_____% Δρ
14.E.

15. Inoperable Rod Reactivity Worth.

NOTE: If all rods are operable per Tech. Spec. 2.10.2(4) a., enter N/A.

Consult the Reactor Engineer to determine the reactivity of the entire rod(s). If unknown, enter a value from lines (1) thru (3) of TDB Figure II.B.1.b. (for each rod) pre-trip configuration. Based on burnup, see 8. above. Select correct column.

_____% Δρ
Total 15

16. Calculate total margin to critical

a. _____% Δρ + _____% Δρ + _____% Δρ
15. 14.e. 11.c.

+(_____% Δρ) - (_____% Δρ) - (_____% Δρ) = _____% Δρ
10. 12.D. 9.g. Total 16.a.

(Inoperable rod worth) + (Total rod withdrawal worth) + (Xenon worth)

+ (Power defect) - (Total rod worth) - (Worth boron change) - (Margin to criticality)

16. b. Add a 0.1% Δρ uncertainty

_____% Δρ + 0.1% Δρ = _____% Δρ
16 a. 16.b.

17. Determine the worth of the most reactive CEA <u>withdrawn</u>. (Use TDB II.B.1.b. with burnup, 8. and rod position, 13.)

_____
17

18. Calculate shutdown margin

a. _____ (17.) % Δρ + _____ (11.c.) % Δρ + _____ (10.) % Δρ

+(_____ (15.) % Δρ) - (_____ (12.D.) % Δρ) - (_____ (9.g.) % Δρ) = _____ (Total 18.a.) % Δρ

(Worth of most reactive CEA) + (Xenon worth) + (Power defect) + (Inoperable rod worth) - (Total rod worth) - (Worth boron conc. change) = (Shutdown margin)

b. Add a 0.1% Δρ for uncertainty

_____ (18.a.) % Δρ + 0.1% Δρ = _____ (18.b.) % Δρ

19. Calculate the difference from the required shutdown margin. (N/A if not applicable.)

a. For hot shutdown (see 6. above).

(_____ (18.b.) % Δρ) + 4.0% Δρ = _____ (19.) % Δρ

b. For cold shutdown (see 6. above).

(_____ (18.b.) % Δρ) + 3.0% Δρ = _____ (19.) % Δρ

If 19 is ≤ 0, shutdown margin is adequate.

If 19 is > 0, use OI-ERFCS-1, Procedure 36 to determine the number of gallons of acid to add.

Fort Calhoun Station
Unit No. 1

TDB-II

TECHNICAL DATA BOOK PROCEDURE

Title: REACTIVITY CURVES

Setpoint/Procedure
Form Number (FC-68): 38234

Reason for Change: Update the reactivity curves for Cycle 14 operation.

Contact Person: Keith Voss

REACTIVITY CURVES

Critical Boron Concentration

Critical Boron Concentration (CBC) data represent the boron concentration (ppm) necessary for reactor criticality. The Cycle 14 CBC versus burnup show a different shape compared to previous cycle's shapes. The CBCs use the base assumptions that the core inlet temperature follows the T-average program. Xenon is at equilibrium and equilibrium Samarium effects are included as a function of burnup.

Figure II.A.1.a - HFP Critical Boron Concentration versus Burnup (^{MWD}/MTU)

Critical Boron Concentration (CBC) at Hot Full Power (HFP) shows the boron concentration (ppm) required for reactor criticality at HFP. The Cycle 14 HFP CBC versus burnup shows that after reaching HFP equilibrium Xenon, operators will need to borate for the approximately the first 2½ months for power level control. After the first 2½ months in the cycle, the CBC will behave as in previous cycles and decrease in a linear fashion. This figure is used with OP-ST-RX-0001, Reactor Anomalies. Unexpected deviations from this curve that require a curve revision are addressed in RE-ST-RX-0006, Normalization of Computed Boron Concentration versus Burnup Curve.

Figure II.A.1.b - HZP Critical Boron Concentration versus Burnup (^{MWD}/MTU)

Critical Boron Concentration (CBC) at Hot Zero Power (HFP) shows the boron concentration (ppm) required for reactor criticality at HZP (532°F). The CBC is based on Equilibrium Samarium, Plutonium buildup and No Xenon which is consistent with continuous full power operation. This figure is used in TDB Procedure TDB-V.1.b, Estimated Critical Conditions Worksheet.

Figure II.A.2.a thru 11.A.2.d - Critical Boron Concentration versus Percent Power

Critical Boron Concentrations (CBC) versus Power shows the boron concentration (ppm) required for reactor criticality at various power levels and burnups. The CBC is based on Equilibrium Xenon and Samarium. The figures are broken down for burnup ranges of 0 to 2,000 ^{MWD}/MTU, 2,000 to 6,000 ^{MWD}/MTU, 6,000 to 10,000 ^{MWD}/MTU and 10,000 to 15,000 ^{MWD}/MTU for clarity. These ranges were chosen because the CBC will be increasing for the first 2½ months of Cycle 14. These figures are made available to operational guidance and information.

Boron Concentration for 4% and 3% Shutdown Margin versus Burnup (MWD/MTU)

The following figures for minimum Boron Concentration required for 4% or 3% Shutdown Margin are used to ensure compliance with Technical Specifications 2.10(1) and 2.10(2). For Cycle 14 a large number of temperatures have been incorporated to give operations more flexibility in meeting the minimum boron concentration during cooldown. In the cooldown process each successive figure's minimum boron value should be achieved prior to cooling down to the next temperature. Two curves are shown on each figure allowing CEA group N to either be in or out. These curves exhibit the same shapes as the CBC versus burnup curves. The figures are based on No Xenon, All rods (ARI) and include uncertainties. These figures are used in performing TDB Procedure TDB-V.9, Shutdown Margin Worksheet, in conjunction with OP-ST-RX-002, Shutdown Margin Verification During Hot Shutdown, Cold Shutdown or Refueling.

Figure II.A.3.a - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure is the first in the series, providing minimum boron concentration required at 532°F.

Figure II.A.3.b - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 515°F.

Figure II.A.3.c - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 500°F.

Figure II.A.3.d - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 475°F.

Figure II.A.3.e - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 450°F.

Figure II.A.3.f - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 400°F.

Figure II.A.3.g - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 350°F.

Figure II.A.3.h - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 210°F.

Figure II.A.3.i - Boron Concentration for 3% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required when temperature is below 210°F. This is a step change in the minimum shutdown margin required utilizes Technical Specification 2.10(2) and allows the shutdown margin to be reduced from 4% to 3%.

Figure II.A.3.i - Boron Concentration for 3% Shutdown Margin versus Burnup

This figure provides minimum born concentration required above 68°F.

Inverse Boron Worth

Inverse Boror Worth is the reciprocal of the boron reactivity worth, i.e. boron concentration corresponding to 1%Δk/k reactivity. IBW versus burnup at Hot Full Power (HFP), and Hot Zero Power (HZP) are presented in this section.

Figure II.A.4 - Inverse Boron Worth vs. Burnup

This Figure shows how Inverse Boron Worth varies over the burnup range of Cycle 14 operations. The non-linear aspect of the graphs in the early part of the cycle is due to the large IFBA loading in the core that is burned out in the first 3000 MWD/MTU of operation. Curves on this graph represent the value at HFP and HZP.

CEA Bank Worths

This section of figures deals with the reactor effects of the CEA's inserted into the core. Figures in this section deal with CEA group insertion into the core, inoperable rod effect on shutdown margin, and sequential group insertion for Groups 1-4. All figures are done at HZP and reflect no Xenon presence. In general, MWD/MTU figures should be utilized between 0 and 3,500 MWD/MTU, 7,000 MWD/MTU figures should be used between 3,500 and 11,000 MWD/MTU, and 15,000 MWD/MTU figures should be used between 11,000 and 15,000 MWD/MTU when not interpolating.

Figure II.B.1.a - Cycle 14 CEA Group Worths in %Δp When Inserted Sequentially

This figure gives the worth of each CEA Group in %Δp when inserted in a sequential manner for 3 timepoints in Cycle 14. This information in this figure is not applicable if the CEA groups are out of the sequence listed.

Figure II.B.1.b - Cycle 14 Reduction in Shutdown Margin or Stuck CEA(s) Worth

This figure gives the Loss of Shutdown Margin when there are known inoperable CEAs. Each CEA is listed independently for subtraction from the Total Shutdown Margin in the event of its inoperability. Values are listed for BOC (0 MWD/MTU) and EOC (15,000 MWD/MTU).

Figure II.B.2.a - Sequential Rod Worth vs Rod Position at 0 MWD/MTU

This figure gives the worth of the rods inserted in the core at BOC conditions for Groups 1-4.

Figure II.B.2.b - Sequential Rod Worth vs Rod Position at 7,000 MWD/MTU

This figure gives the worth of the rods inserted in the core at MOC conditions for Groups 1-4.

Figure II.B.2.c - Sequential Rod Worth vs Rod Position at 15,000 MWD/MTU

This figure gives the worth of the rods inserted in the core at EOC conditions for Groups 1-4.

Figure II.B.3.a - Group 4 Integral Rod Worth at 0 MWD/MTU

This figure gives the worth of Group 4 inserted in the core at BOC conditions for CEA Group 4.

Figure II.B.3.b - Group 4 Integral Rod Worth at 7,000 MWD/MTU

This figure gives the worth of Group 4 inserted in the core at MOC conditions for CEA Group 4.

Figure II.B.3.c - Group 4 Rod Worth vs Rod Position at 15,000 MWD/MTU

This figure gives the worth of Group 4 inserted in the core at EOC conditions for CEA Group 4.

Excess Reactivity versus Burnup

Figure II.C.1 - Excess Reactivity versus Burnup

Excess reactivity is a measure of the amount of energy in the reactor core above and beyond what is required to achieve criticality at full power with equilibrium Xenon and All Rods Out (ARO). The excess reactivity versus burnup curve is used in performing OP-ST-RX-0001, Reactivity Anomalies, as per Technical Specification 3.10(1)b. The overall core reactivity balance shall demonstrate agreement with 1.0%Δk/k. This curve accounts for all reactivity effects in the core at HFP, ARO.

Power Defect versus Power

Power Defect versus power shows the power defect from 0 to 100% power for specific burnup ranges. The assumptions used at each power level in determing the power defect are CBC, equilibrium Xenon and ARO. Power Defect is used in OP-ST-RX-0001, Reactivity Anomalies; OP-ST-RX-0002, Shutdown Margin Determination, and TDB Procedure TDB-V.1.b, Estimated Critical Conditions Worksheet.

Figure II.C.2.a - Power Defect versus Power (0 to 6,000 MWD/MTU

This figure provides the power defect versus power for three burnup ranges: BOC to 4,000 MWD/MTU, 4,000 to 5,000 MWD/MTU and 5,000 to 6,000 MWD/MTU.

Figure II.C.2.b - Power Defect versus Power (6,000 to 11,000 MWD/MTU)

This figure provides the power defect versus power for five burnup ranges: 6,000 to 7,000 MWD/MTU; 7,000 to 8,000 MWD/MTU; and 8,000 to 9,000 MWD/MTU; 9,000 to 10,000 MWD/MTU and 10,000 to 11,000 MWD/MTU.

Figure II.C.2.c - Power Defect versus Power (11,000 to 15,000 MWD/MTU)

This figure provides the power defect versus power with four burnup ranges: 11,000 to 12,000 MWD/MTU; 12,000 to 13,000 MWD/MTU; and 13,000 to 14,000 MWD/MTU; and 14,000 to 15,000 MWD/MTU.

Moderator Temperature Coefficient

Figure II.C.4 - Moderator Temperature Coefficient vs Burnup

This figure shows the change in core reactivity due to changes in moderator temperature. This is used to calculate changes due to inlet temperature variations and other changes to the average moderator temperature, such as changes in turbine load.

Xenon Reactivity Worths

The figures in this section deal with the effect of the most significant fission product, Xenon-135 and its effect on core reactivity during equilibrium operation at all power levels, full power operation for all points during the cycle, and for 60 hours after the time of trip for different power levels. These figures assume equilibrium conditions with the exception of the Xenon worth after tip which assumes equilibrium Xenon prior to trip. These figures are used in TDB Procedure TDB-V.1.b. Estimated Critical Conditions Worksheet.

Figure II.D.1.a - Equilibrium Xenon Reactivity vs Percent Power

This figure provides the reactivity worth for the Xenon present in the core for equilibrium conditions at all power levels for three timepoints during the cycle: 0 MWD/MTU; 7,000 MWD/MTU; and 15,000 MWD/MTU.

Figure II.D.1.b - HFP Equilibrium Xenon Worth vs Burnup

This figure provides the reactivity worth for the Xenon at HFP for any burnup during the cycle. It would also be useful for scaling other Xenon worths to a particular burnup in cycle.

Figure II.D.2 - Xenon Worth After Trip (At 100%, 80%, 60%, 40%, and 20% power)

This figure provides the reactivity worth for Xenon after a reactor trip from five different power levels (100%, 80%, 60%, 40%, and 20%) at 7,000 MWD/MTU. This timepoint was chosen to best represent the entire cycle. Other burnup points can be approximated by scaling the value at a particular time to the ratio of HFP Equilibrium Xenon Worth between the timepoint of interest and 7,000 MWD/MTU.

Figure II.A.1.a

Cycle 14 Critical Boron Concentration vs Burnup

(ARO, Hot Zero Power, NO Xenon)

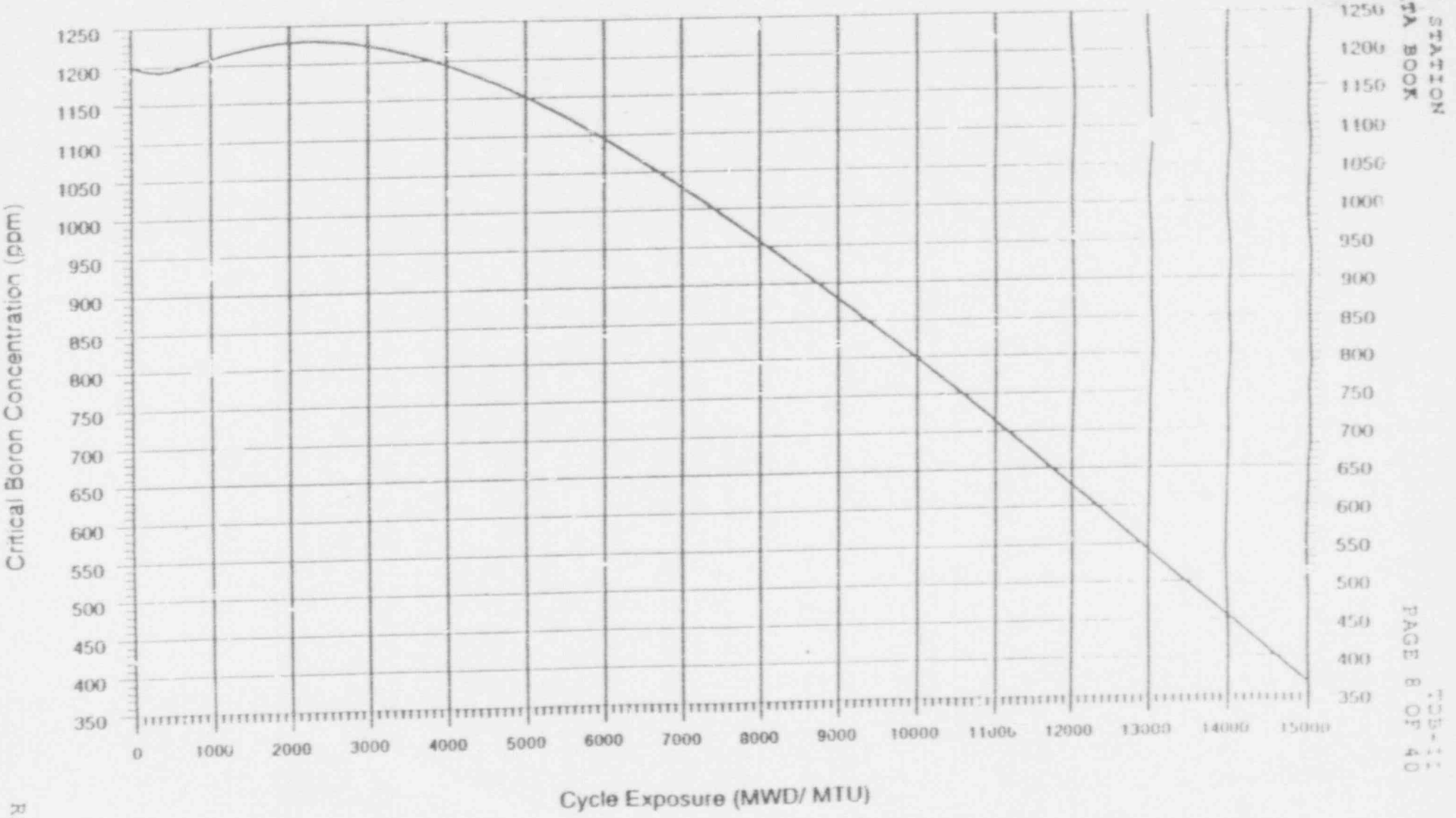


Figure II.A.1.b

Cycle 14 Critical Boron Concentration vs Burnup

(ARO, Hot Full Power, Equilibrium Xenon)

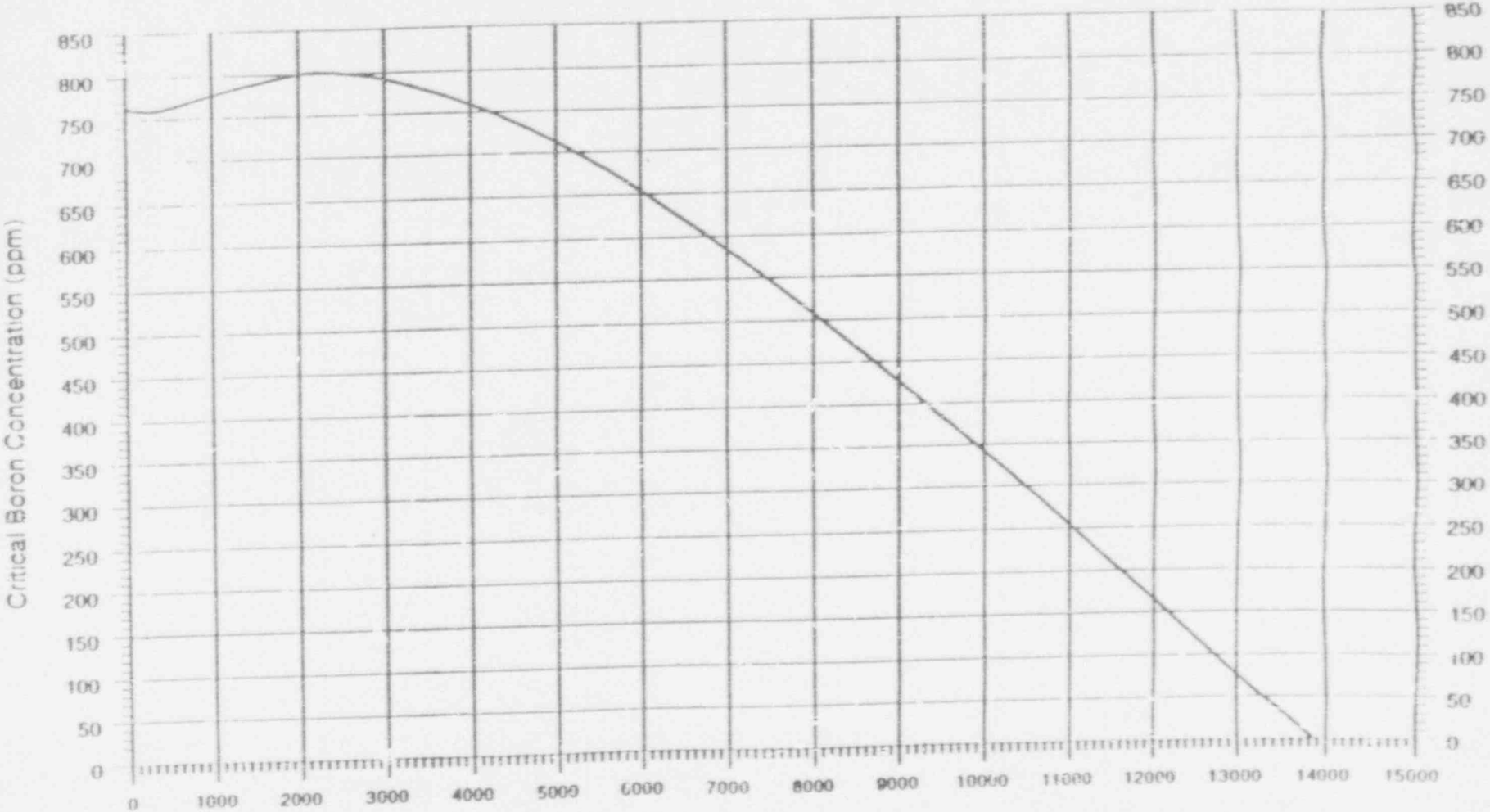


Figure II.A.2.a

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

BOC to 2,000 MWD/MTU

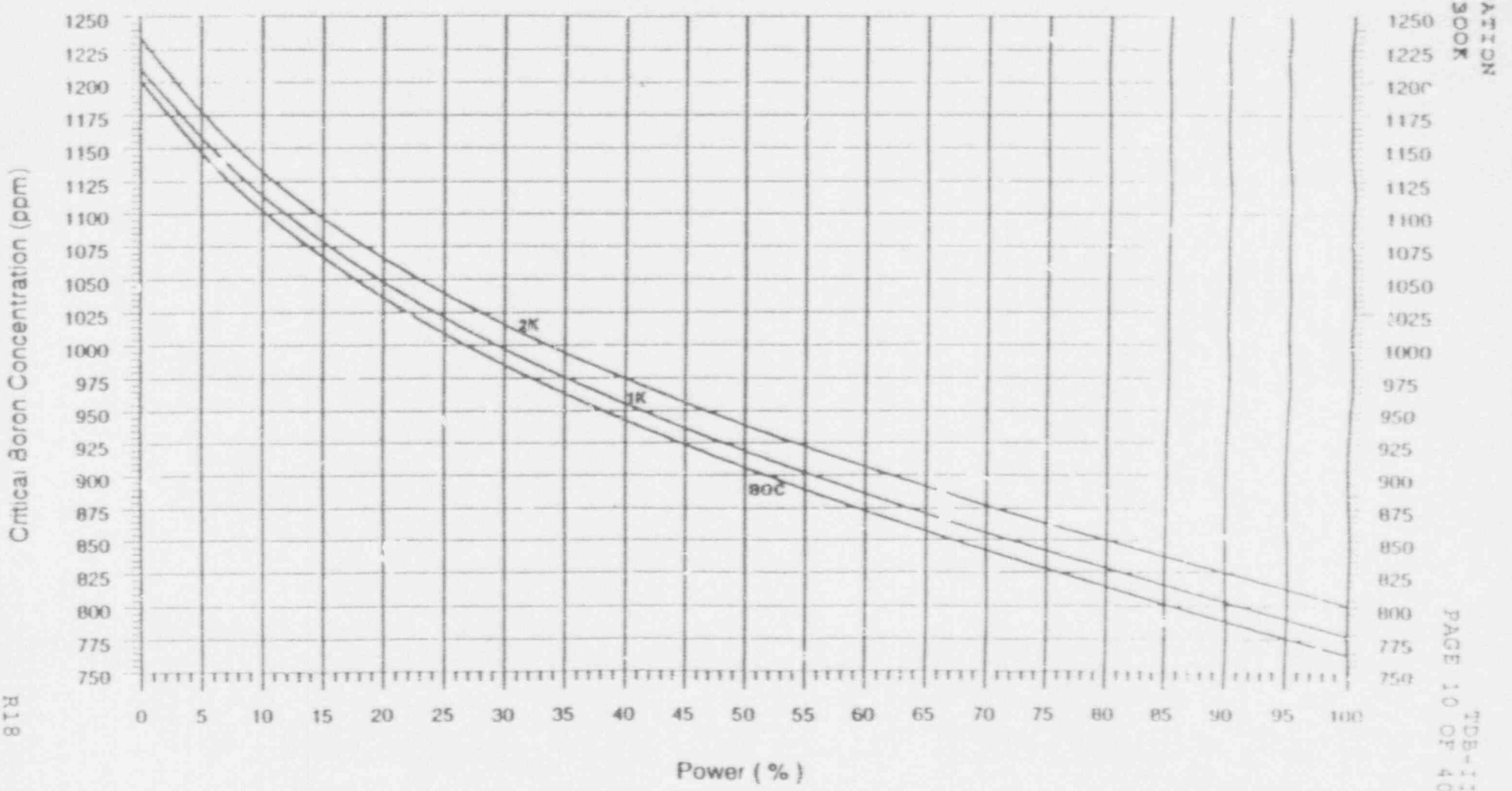


Figure II.A.2.b

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

2,000 MWD/MTU to 6,000 MWD/MTU

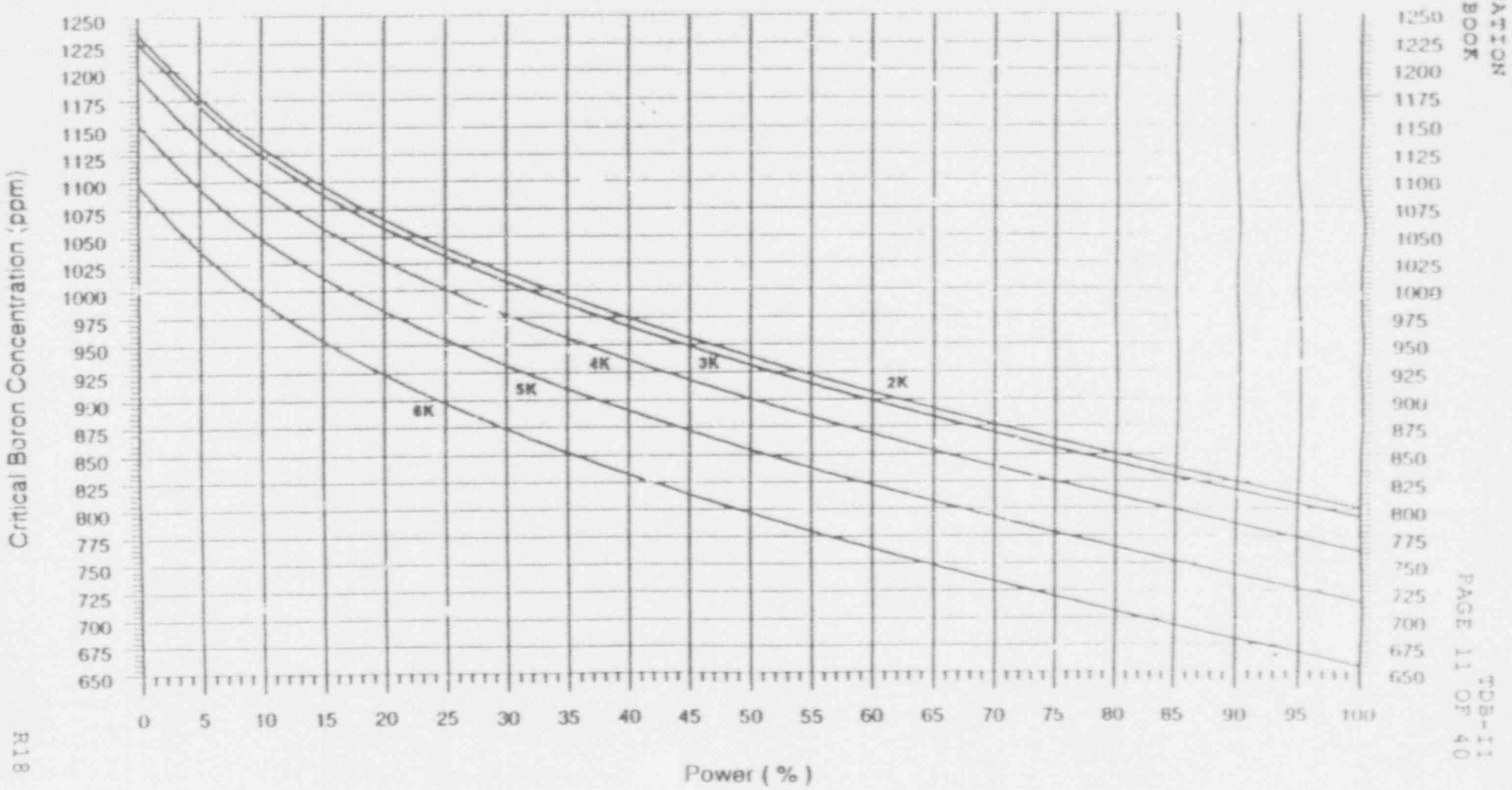


Figure II.A.2.c

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

6,000 MWD/MTU to 10,000 MWD/MTU

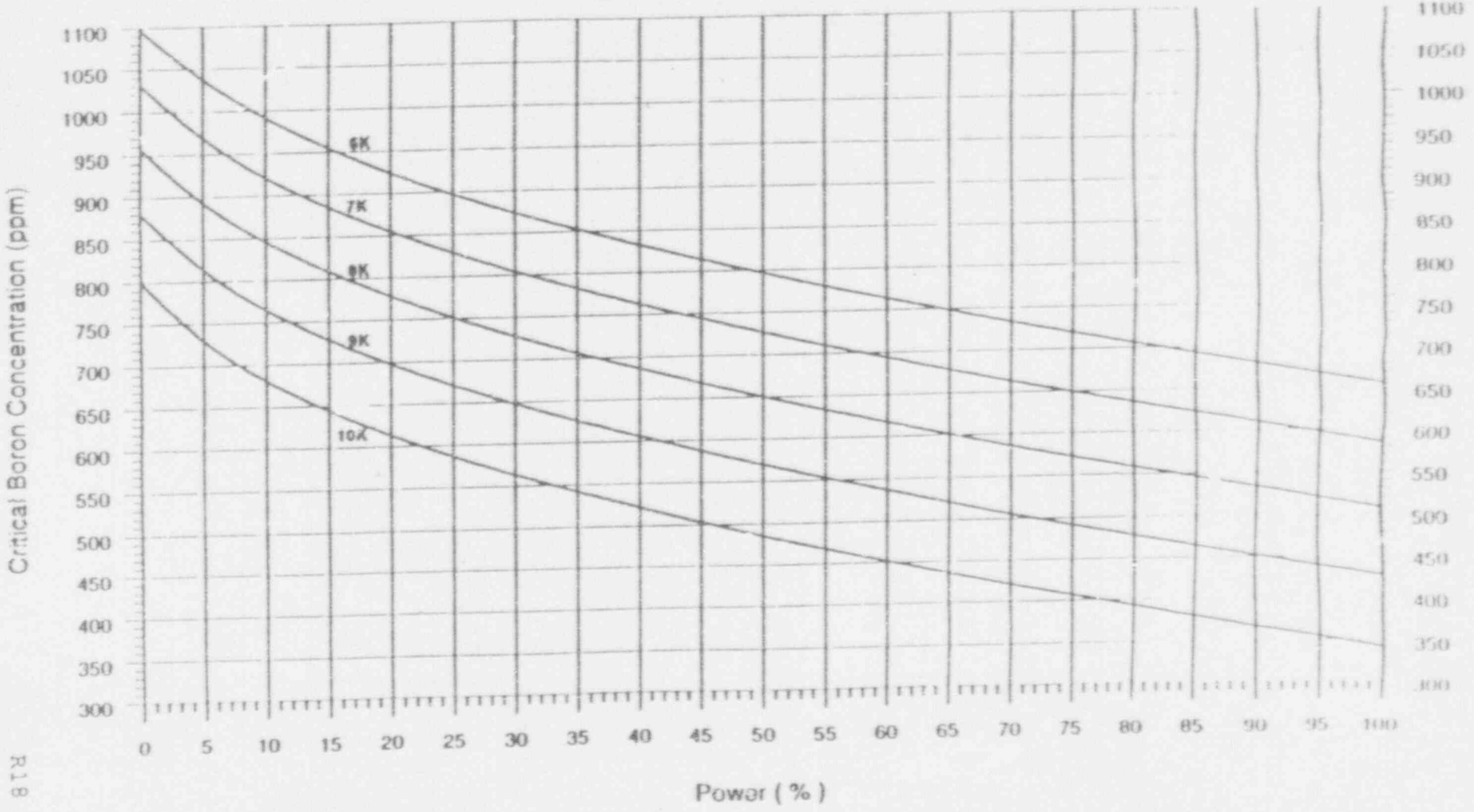
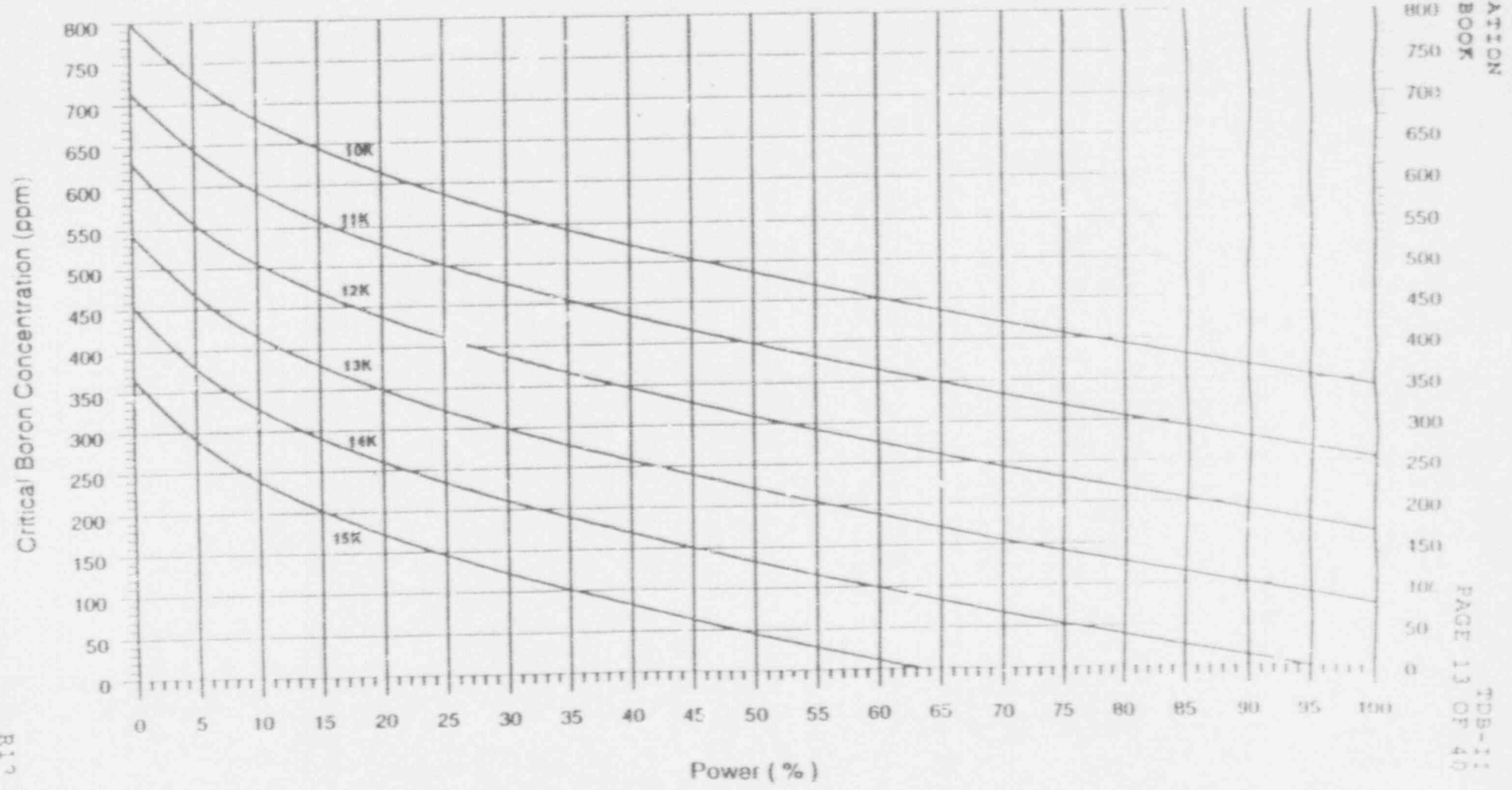


Figure II.A.2.d

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

10,000 MWD/MTU to 15,000 MWD/MTU



R13

Figure II.A.3.a

Cycle 14 Minimum Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 532 Degrees F, Equilibrium Samarium)

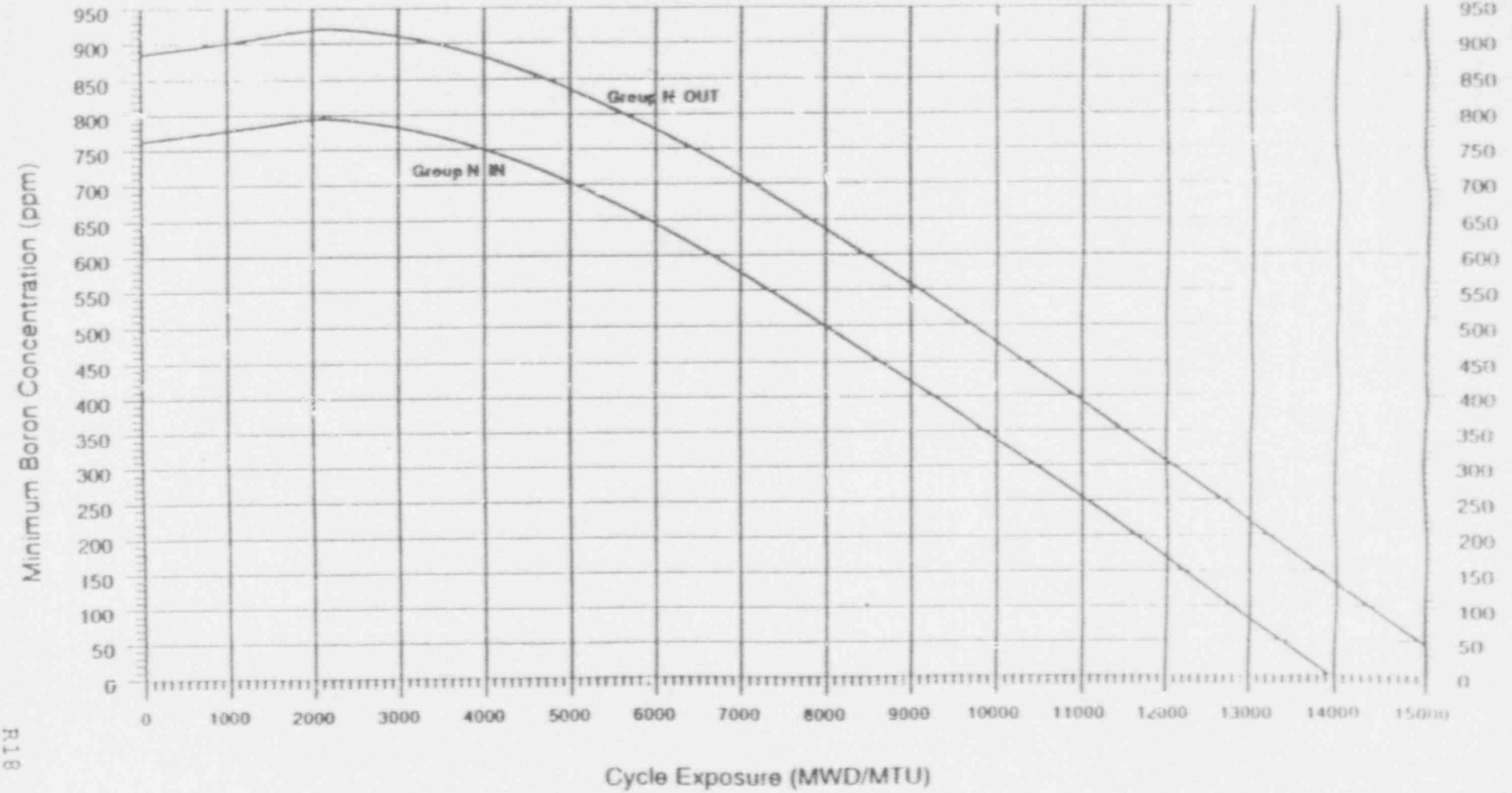


Figure II.A.3.b

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 515 Degrees F, Equilibrium Samarium)

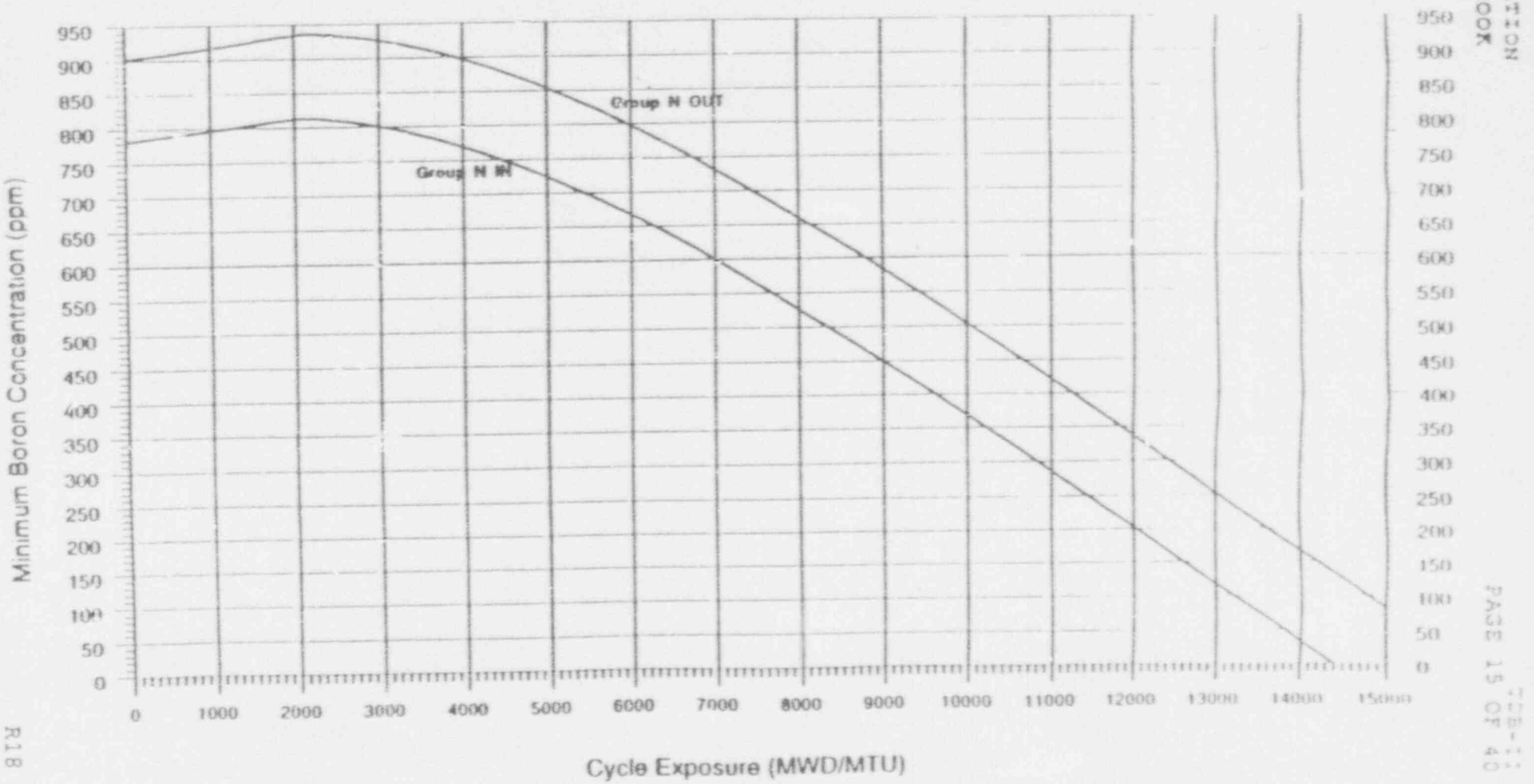


Figure II.A.3.c

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 500 Degrees F, Equilibrium Samarium)

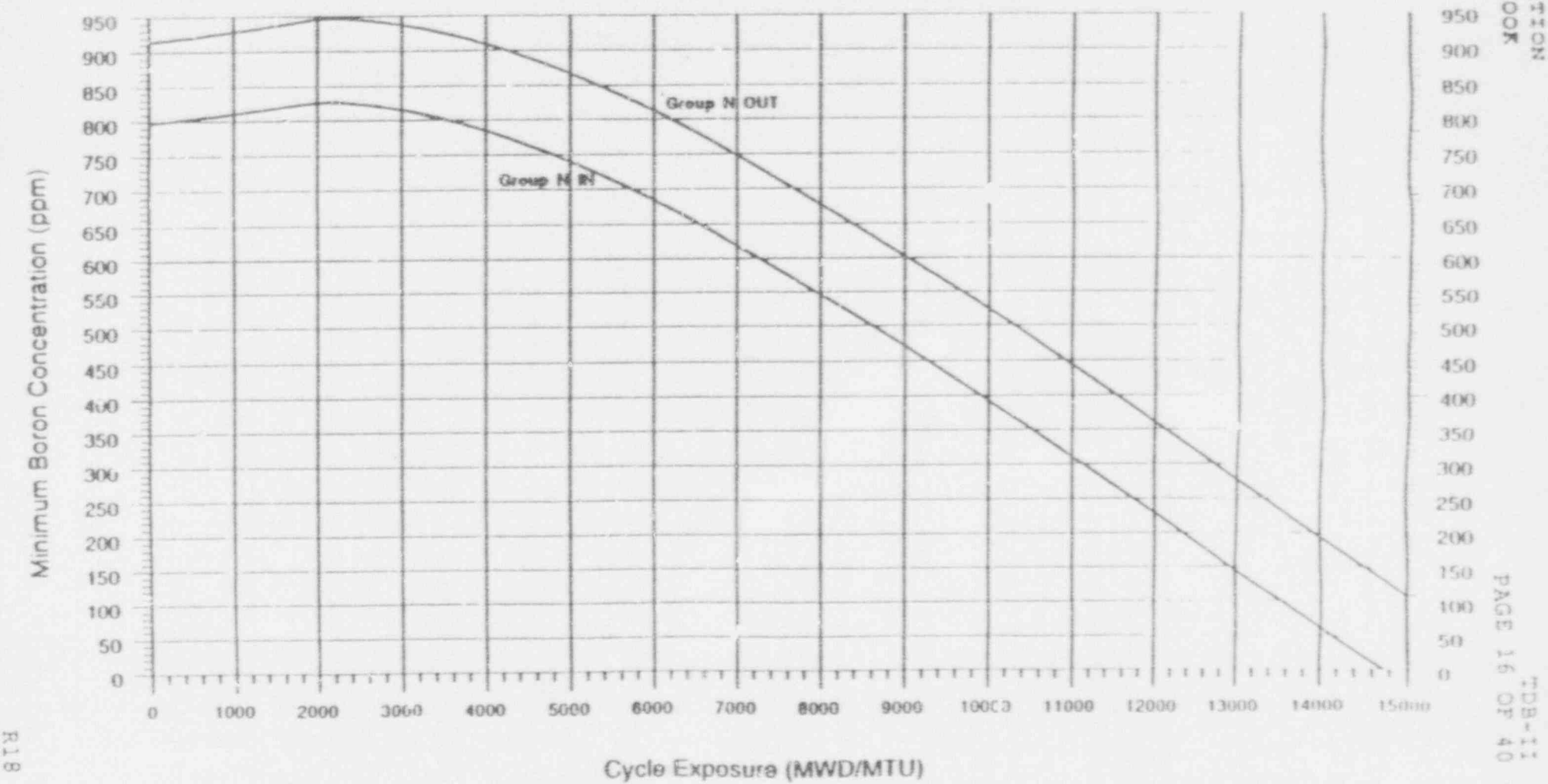
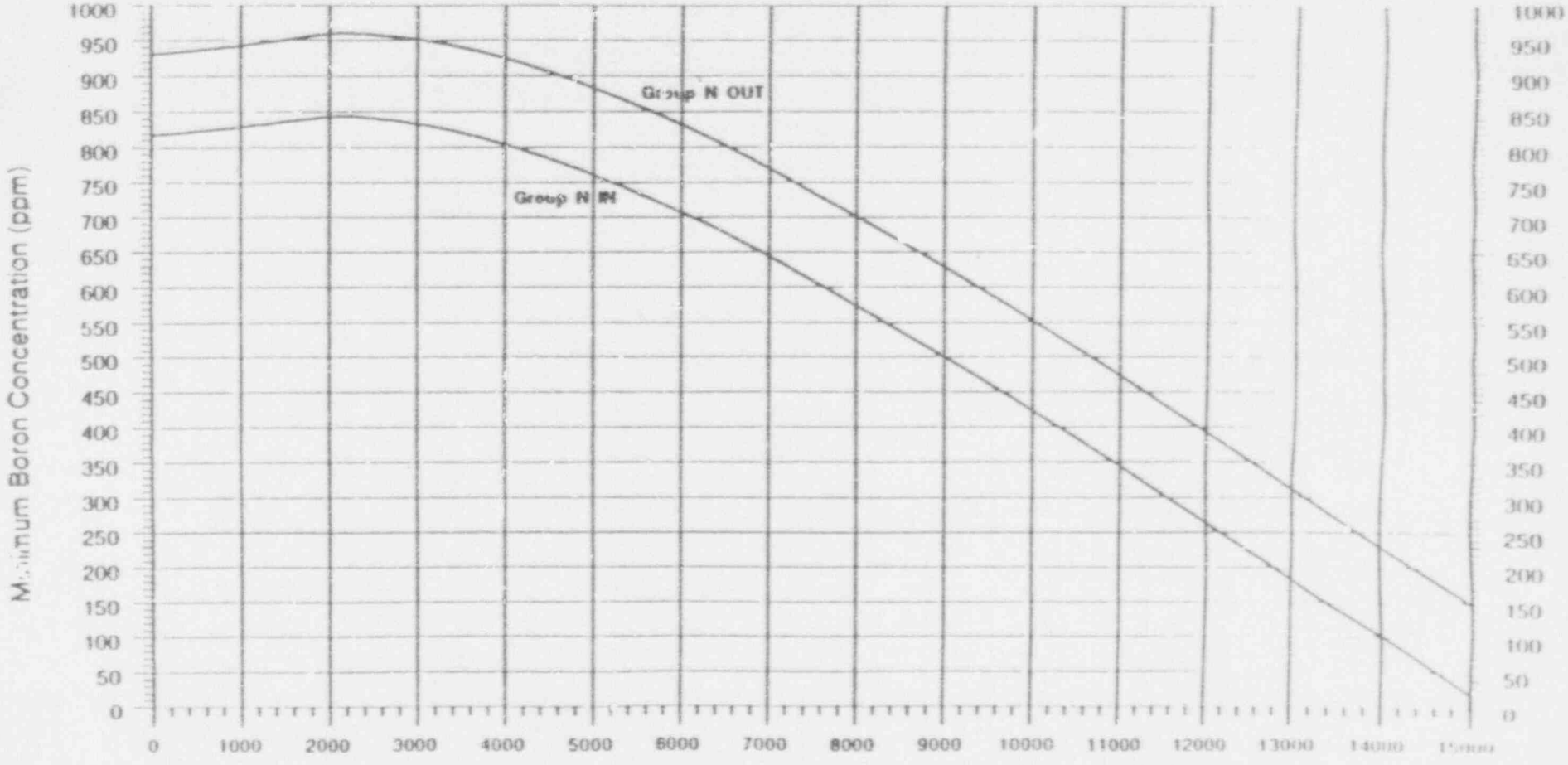


Figure II.A.3.d

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 475 Degrees F, Equilibrium Samarium)



R18

Figure II.A.3.e

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 450 Degrees F, Equilibrium Samarium)

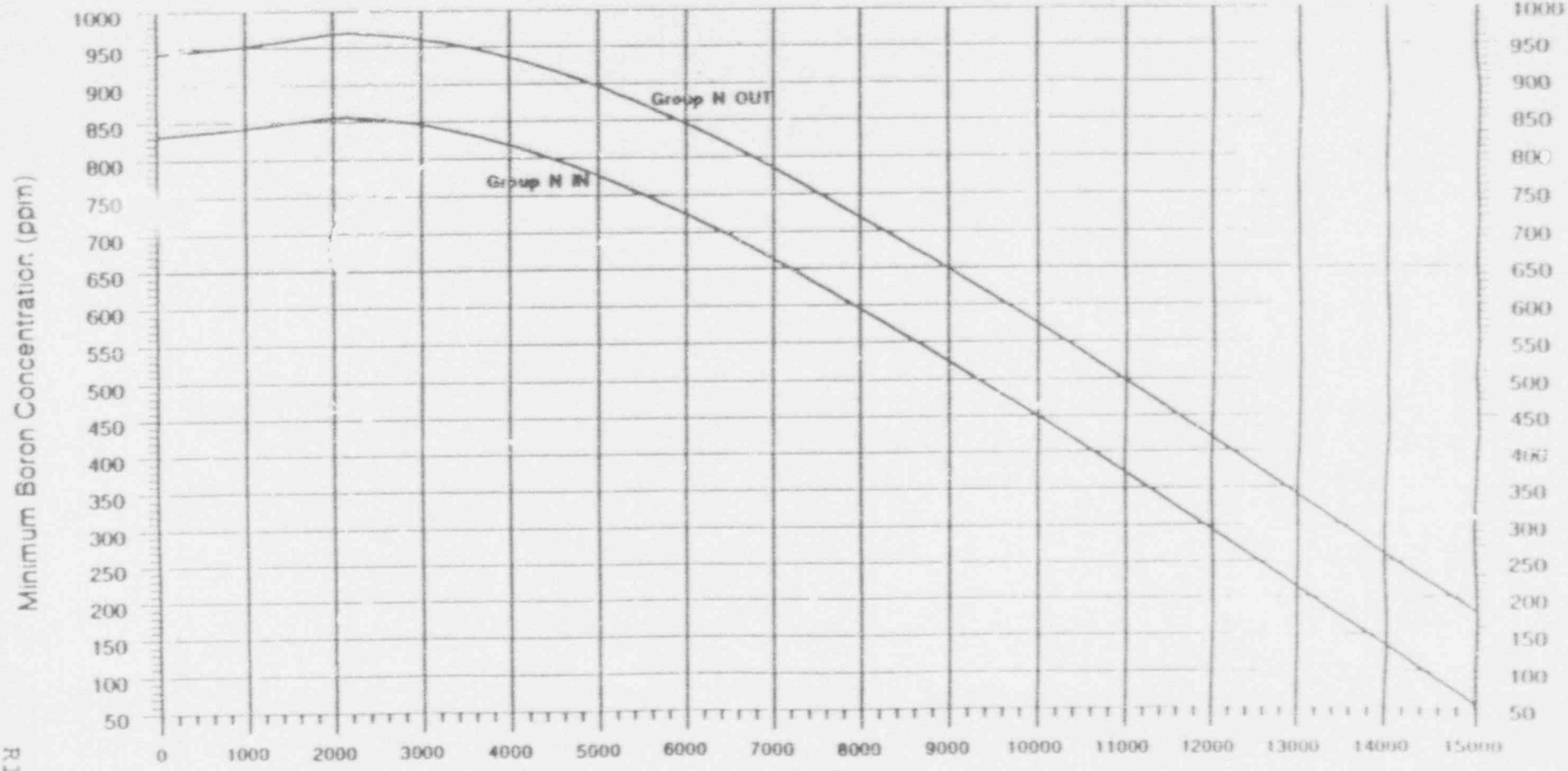


Figure II.A.3.1

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 400 Degrees F, Equilibrium Samarium)

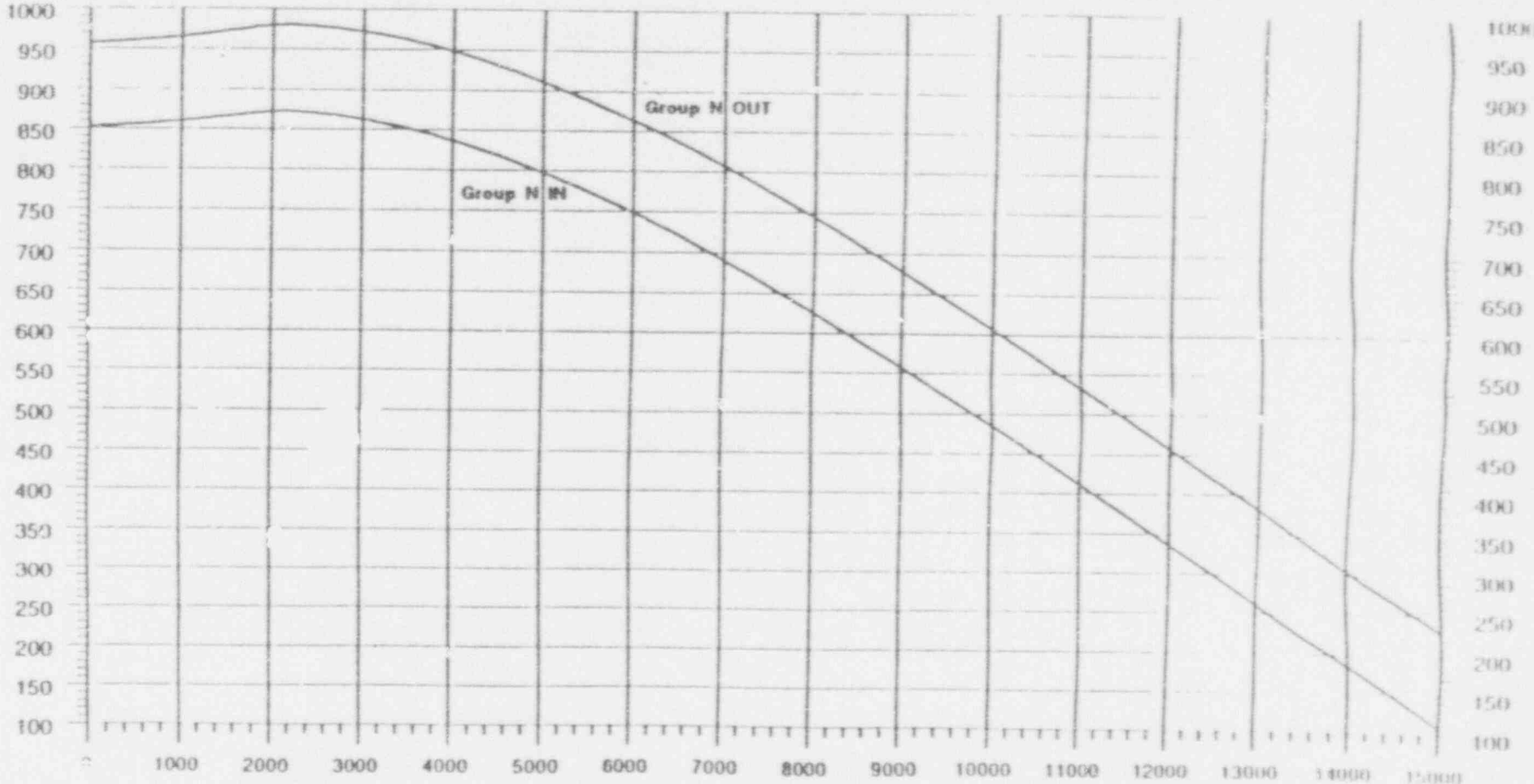


Figure II.A.3.g

Cycle 14 Bcron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 350 Degrees F, Equilibrium Samarium)

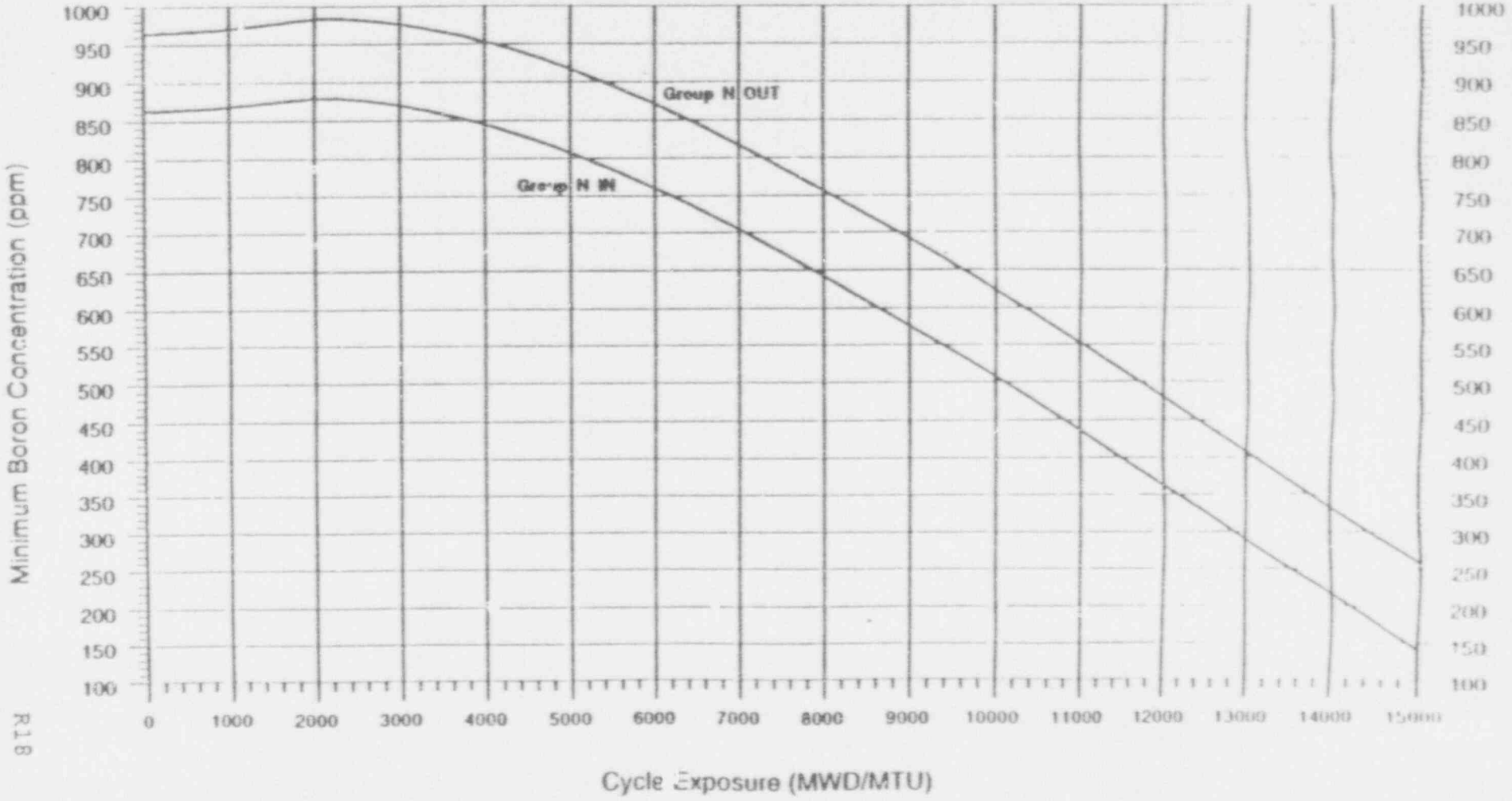


Figure II.A.3.h

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 210 Degrees F, Equilibrium Samarium)

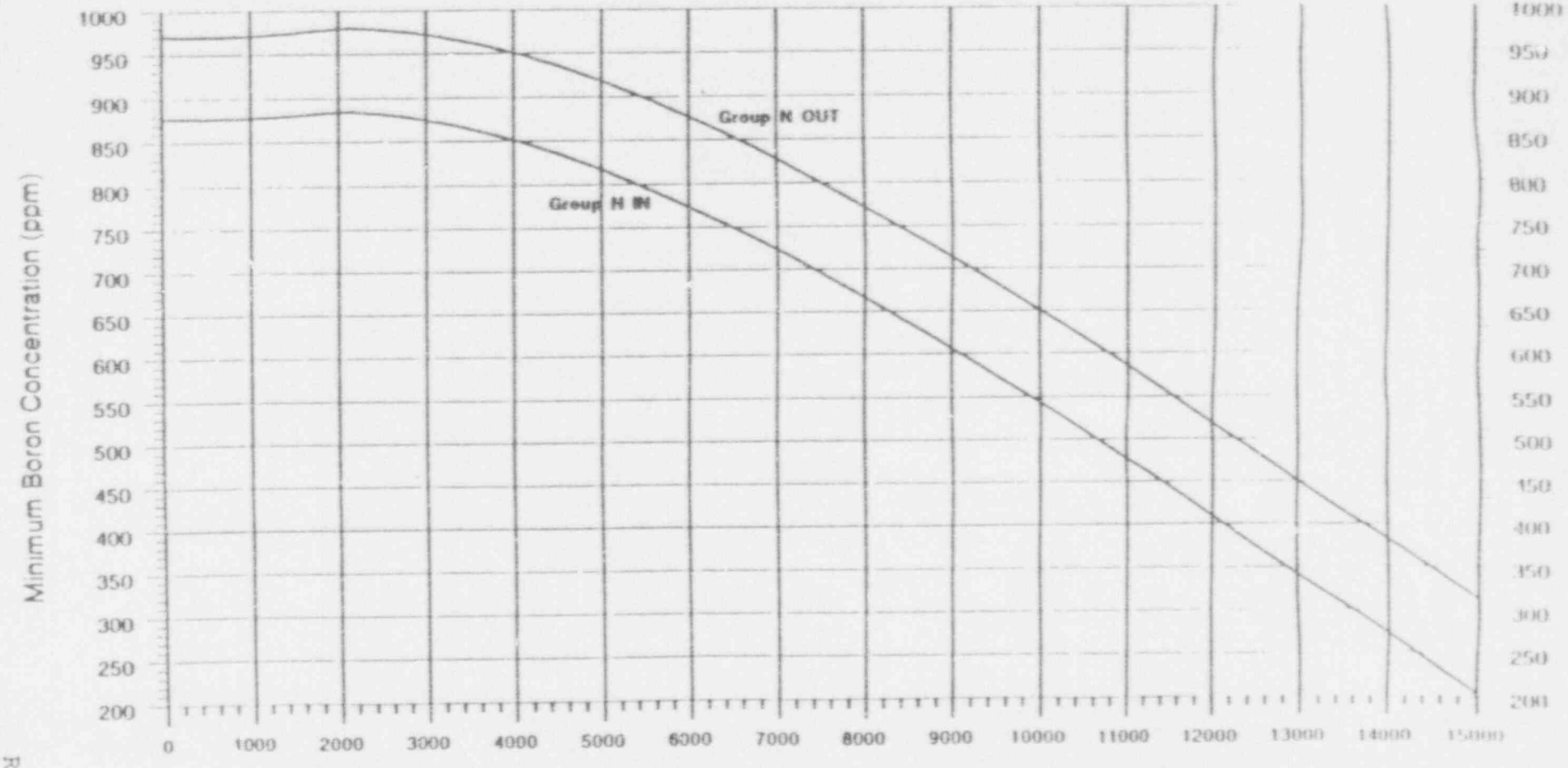


Figure II.A.3-1

Cycle 14 Boron Concentration for 3% Shutdown Margin vs Burnup

(ARI, Zero Power - 210 Degrees F, Equilibrium Samarium)

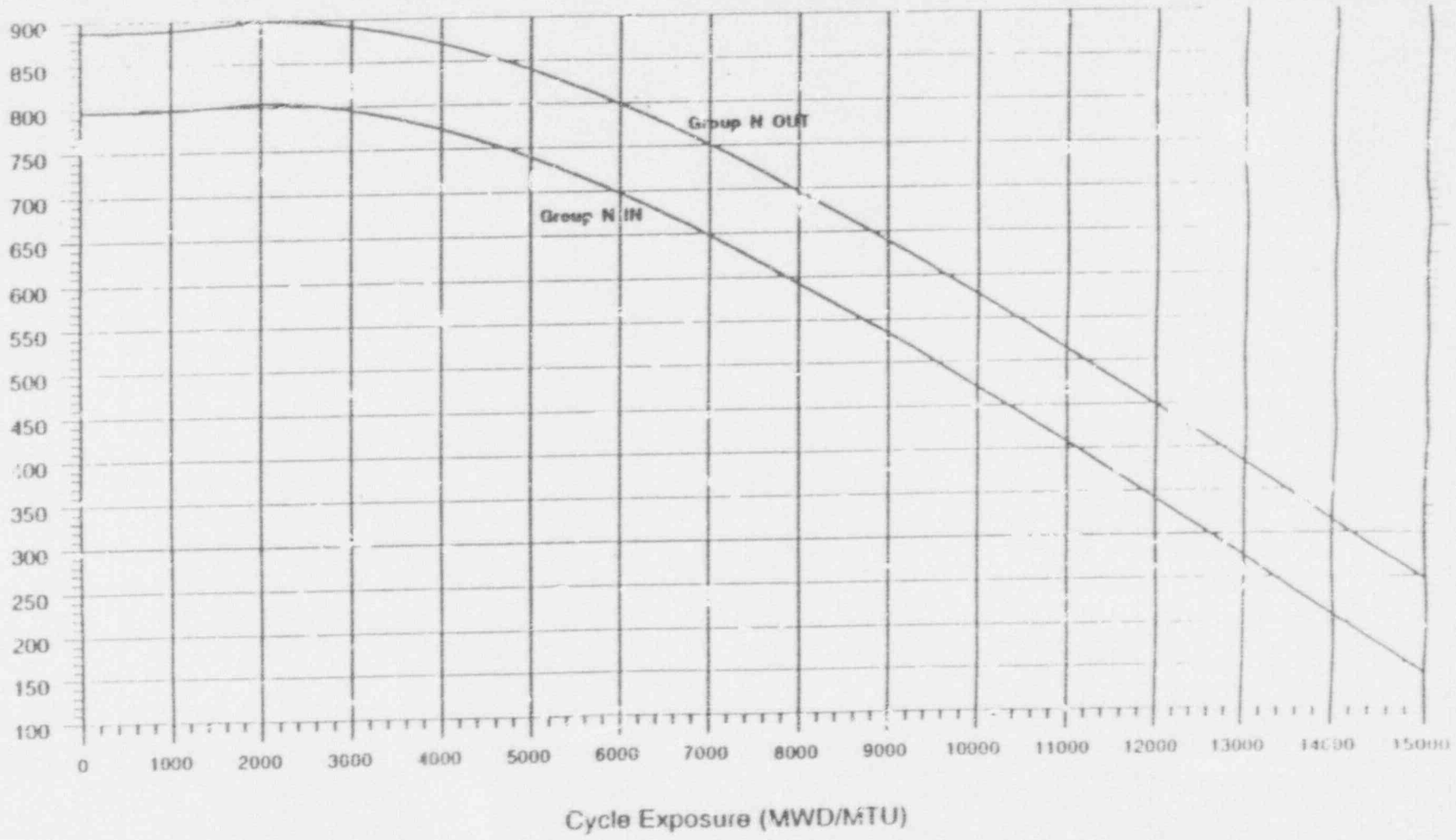


Figure II.A.3.j

Cycle 14 Boron Concentration for 3% Shutdown Margin vs Burnup

(ARI, Zero Power - 68 Degrees F, Equilibrium Samarium)

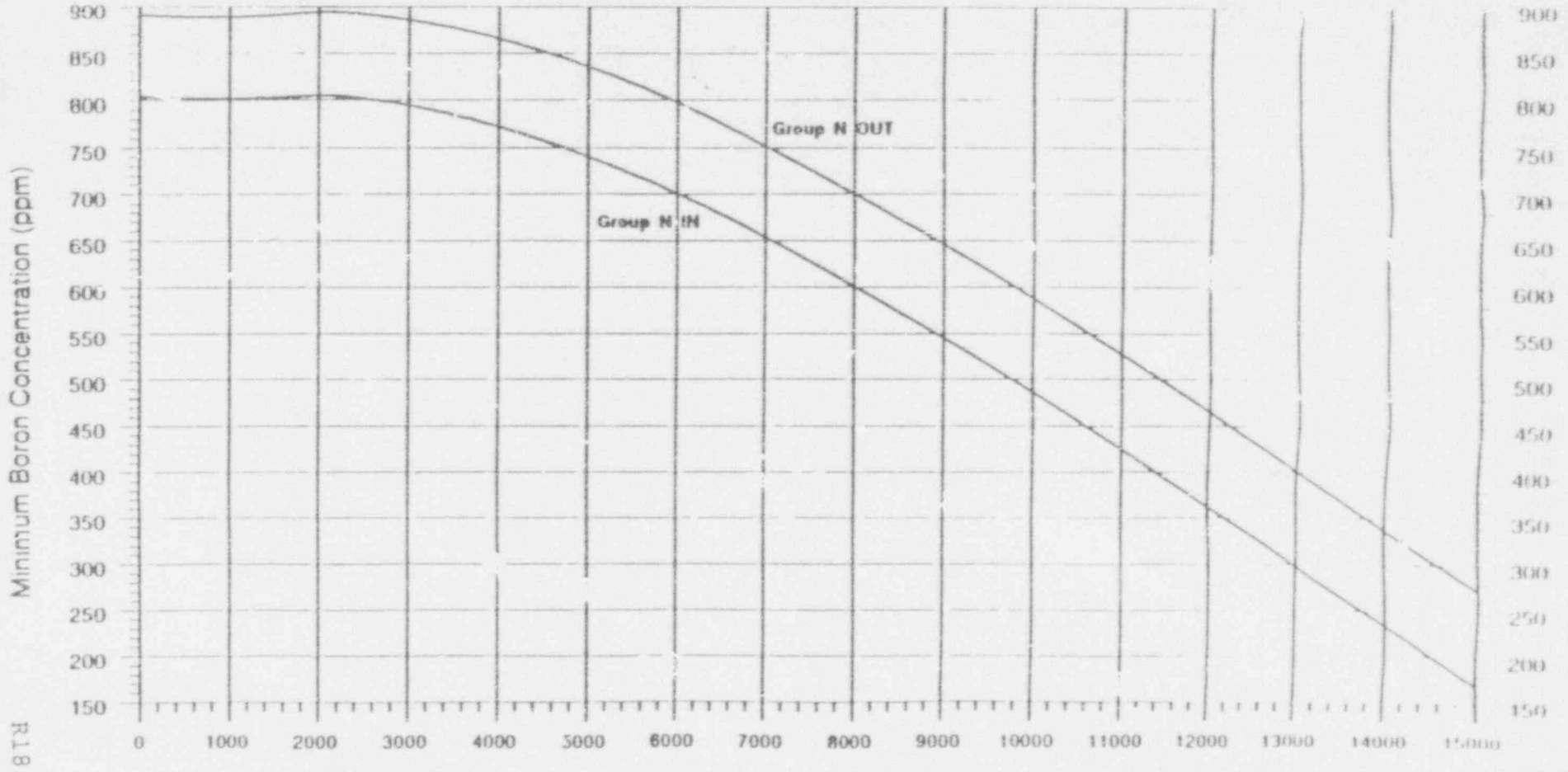


Figure 1.A.4

Cycle 14 Inverse Boron Worth vs Burnup

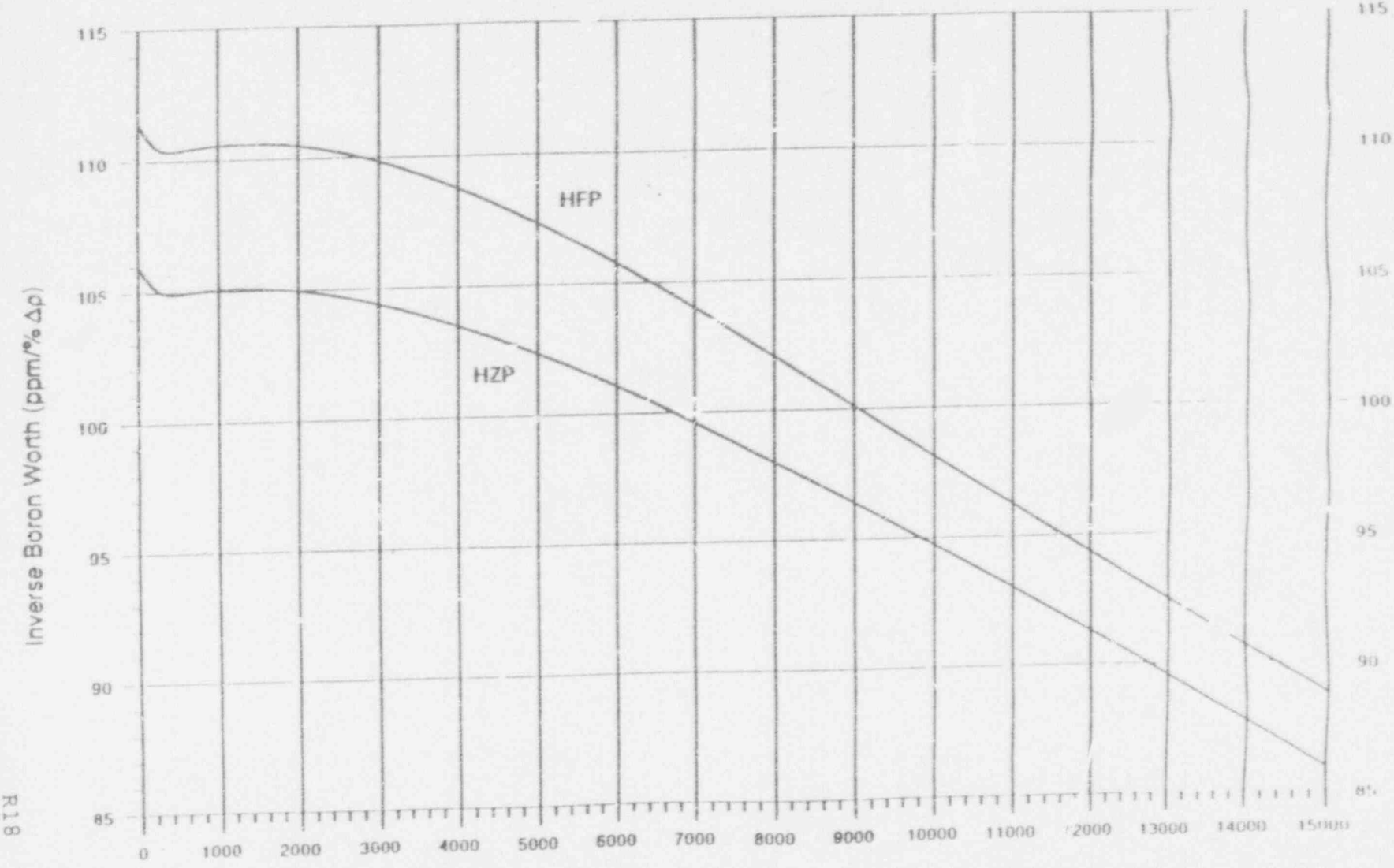


Figure II.B.1.a

Table 1
FORT CALHOUN STATION CYCLE 14
CEA GROUP WORTHS AT HZP IN %Δρ
WHEN INSERTED SEQUENTIALLY

	0 $^{MWD}/_{MTU}$	7.000 $^{MWD}/_{MTU}$	15.000 $^{MWD}/_{MTU}$
Group 4	0.61	0.52	0.57
Group 3	0.66	0.91	0.82
Group 2	1.14	1.06	1.33
Group 1	0.88	1.07	1.08
Group A	2.31	2.69	3.14
Group B	2.32	2.24	2.35
Group N	1.10	1.20	1.41
Total Worth without Group N *	7.91	8.48	9.31
Total Worth with Group N *	9.01	9.68	10.72

* Rod Totals do not equal the sum of individual banks due to roundoff.

Figure II.B.1.b

Table 2
FORT CALHOUN STATION CYCLE 14
REDUCTION IN SHUTDOWN MARGIN OR STUCK CEA(s) WORTH

CEA Conditions*	Stuck CEA(s) Worth on Reduction in Total CEA Worth at HZP 0 $^{MWD}/_{MTU}$ (%Δρ)	15,000 $^{MWD}/_{MTU}$ (%Δρ)
ARO, No Known Inoperable	1.22	1.55
Group 4 In, No Known Inoperable	1.22	1.55
Groups 4+3 In, No Known Inoperable	1.22	1.55
ARO, Group 4 – CEA 1 Known Inoperable	1.80	2.17
ARO, Group 4 – CEA 38 Known Inoperable	2.00	2.61
ARO, Group 4 – CEA 39 Known Inoperable	2.00	2.61
ARO, Group 4 – CEA 40 Known Inoperable	2.00	2.61
ARO, Group 4 – CEA 41 Known Inoperable	2.00	2.61
ARO, Group 3 – CEA 2 Known Inoperable	2.02	2.70
ARO, Group 3 – CEA 3 Known Inoperable	2.08	2.78
ARO, Group 3 – CEA 4 Known Inoperable	2.02	2.70
ARO, Group 3 – CEA 5 Known Inoperable	2.08	2.78
ARO, Group 2 – CEA 22 Known Inoperable	2.30	3.42
ARO, Group 2 – CEA 23 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 24 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 25 Known Inoperable	2.30	3.42
ARO, Group 2 – CEA 26 Known Inoperable	2.30	3.42
ARO, Group 2 – CEA 27 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 28 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 29 Known Inoperable	2.30	3.42
ARO, Group 1 – CEA 6 Known Inoperable	2.05	2.70
ARO, Group 1 – CEA 8 Known Inoperable	2.08	2.78
ARO, Group 1 – CEA 10 Known Inoperable	2.05	2.70
ARO, Group 1 – CEA 12 Known Inoperable	2.08	2.78
ARO, Group B – CEA 14 Known Inoperable	3.15	3.95
ARO, Group B – CEA 15 Known Inoperable	3.15	3.95
ARO, Group B – CEA 16 Known Inoperable	3.15	3.95
ARO, Group B – CEA 17 Known Inoperable	3.15	3.95
ARO, Group A – CEA 30 Known Inoperable	3.15	3.95
ARO, Group A – CEA 31 Known Inoperable	2.15	2.67
ARO, Group A – CEA 32 Known Inoperable	2.15	2.67
ARO, Group A – CEA 33 Known Inoperable	3.15	3.95
ARO, Group A – CEA 34 Known Inoperable	3.15	3.95
ARO, Group A – CEA 35 Known Inoperable	2.15	2.67
ARO, Group A – CEA 36 Known Inoperable	2.15	2.67
ARO, Group A – CEA 37 Known Inoperable	3.15	3.95

* Inoperable CEA is assumed to be "stuck out". All groups not specifically inserted are assumed to be 100% withdrawn

Figure II.B.2.a

Cycle 14 Sequential Rod Worth vs. Rod Position at 0 MWD/MTU

Groups 1-4

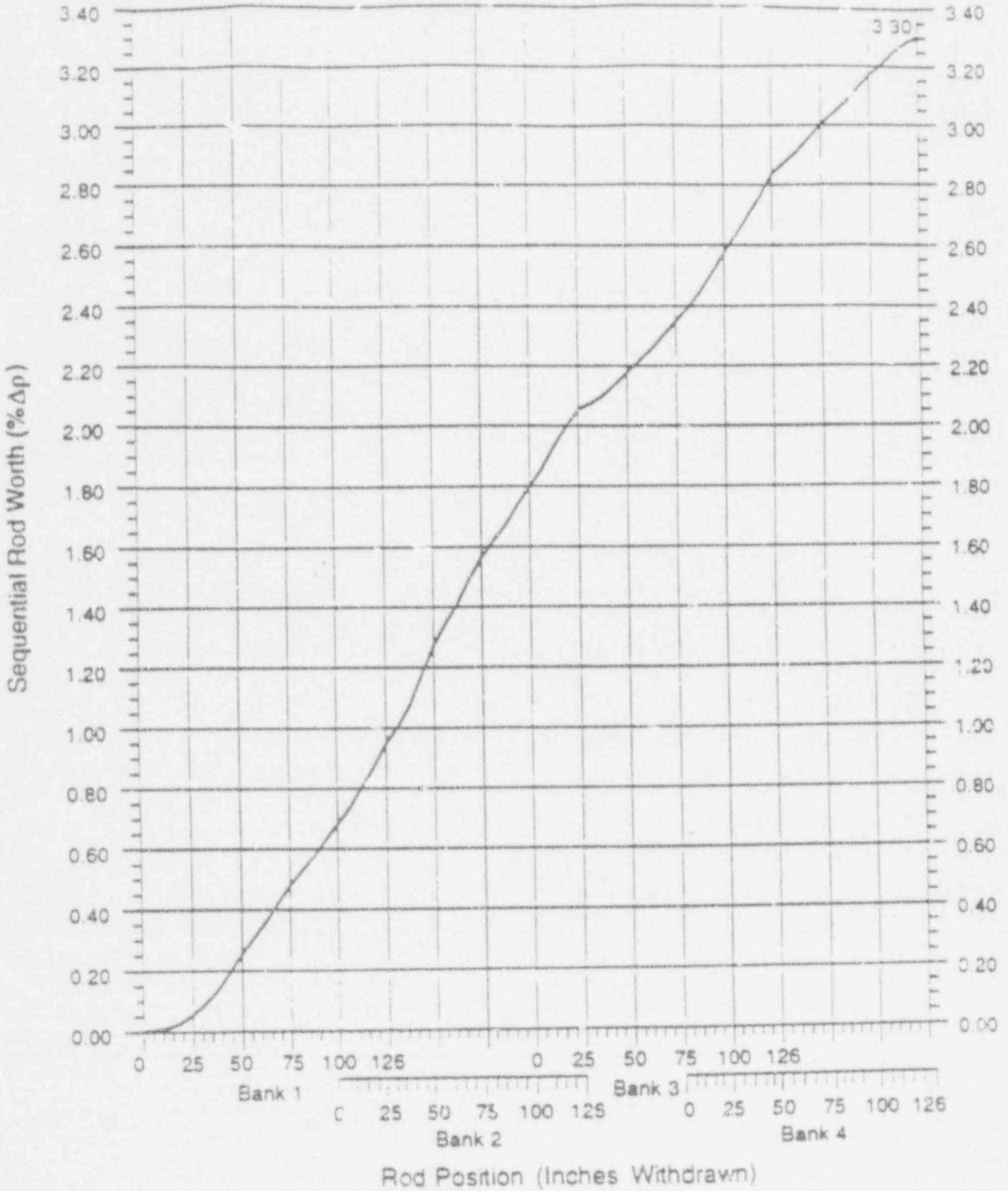


Figure II.B.2.b

Cycle 14 Sequential Rod Worth vs. Rod Position at 7,000 MWD/MTU

Groups 1-4

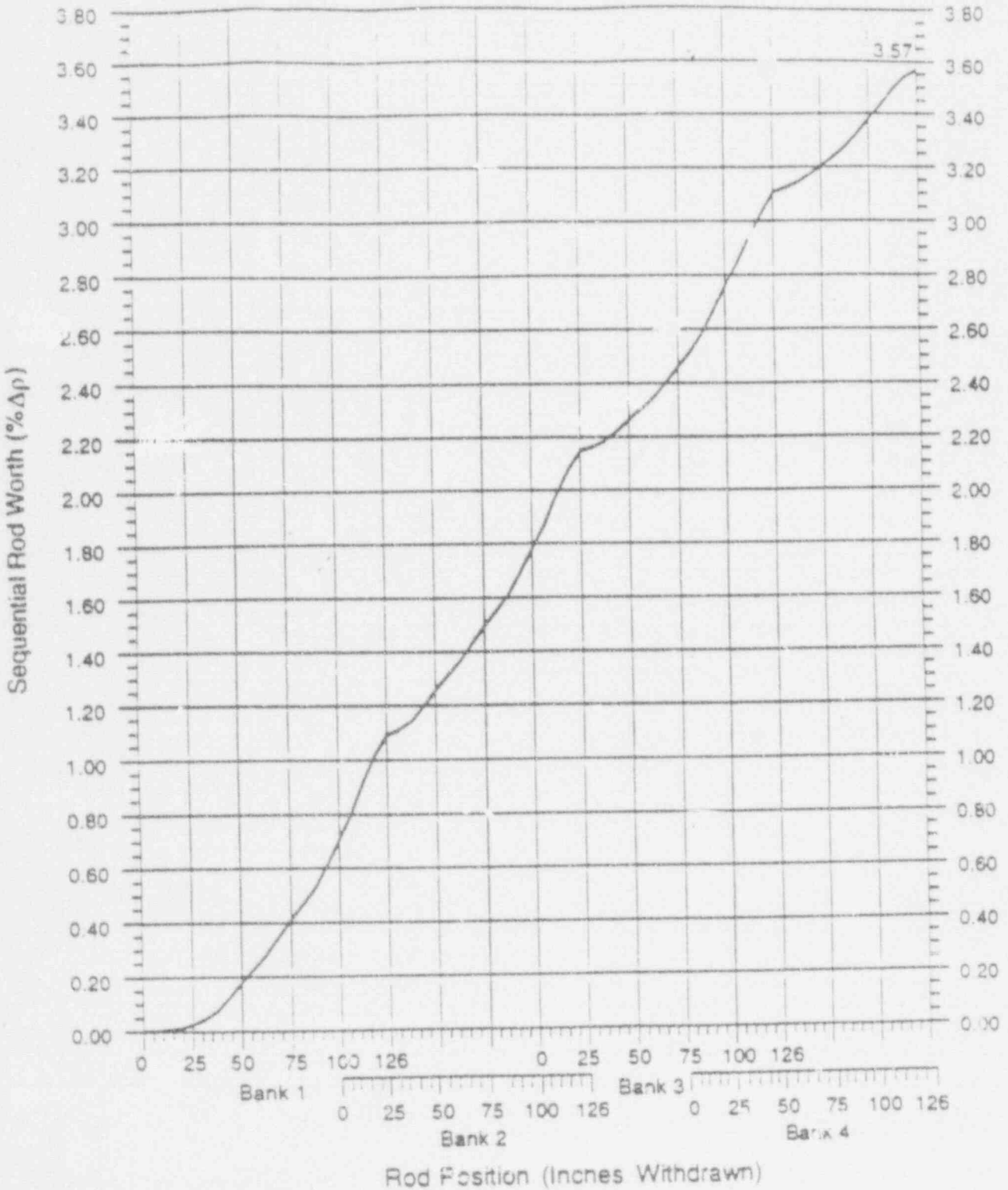


Figure II.B.2.c

Cycle 14 Sequential Rod Worth vs. Rod Position at 15,000 MWD/MTU

Groups 1-4

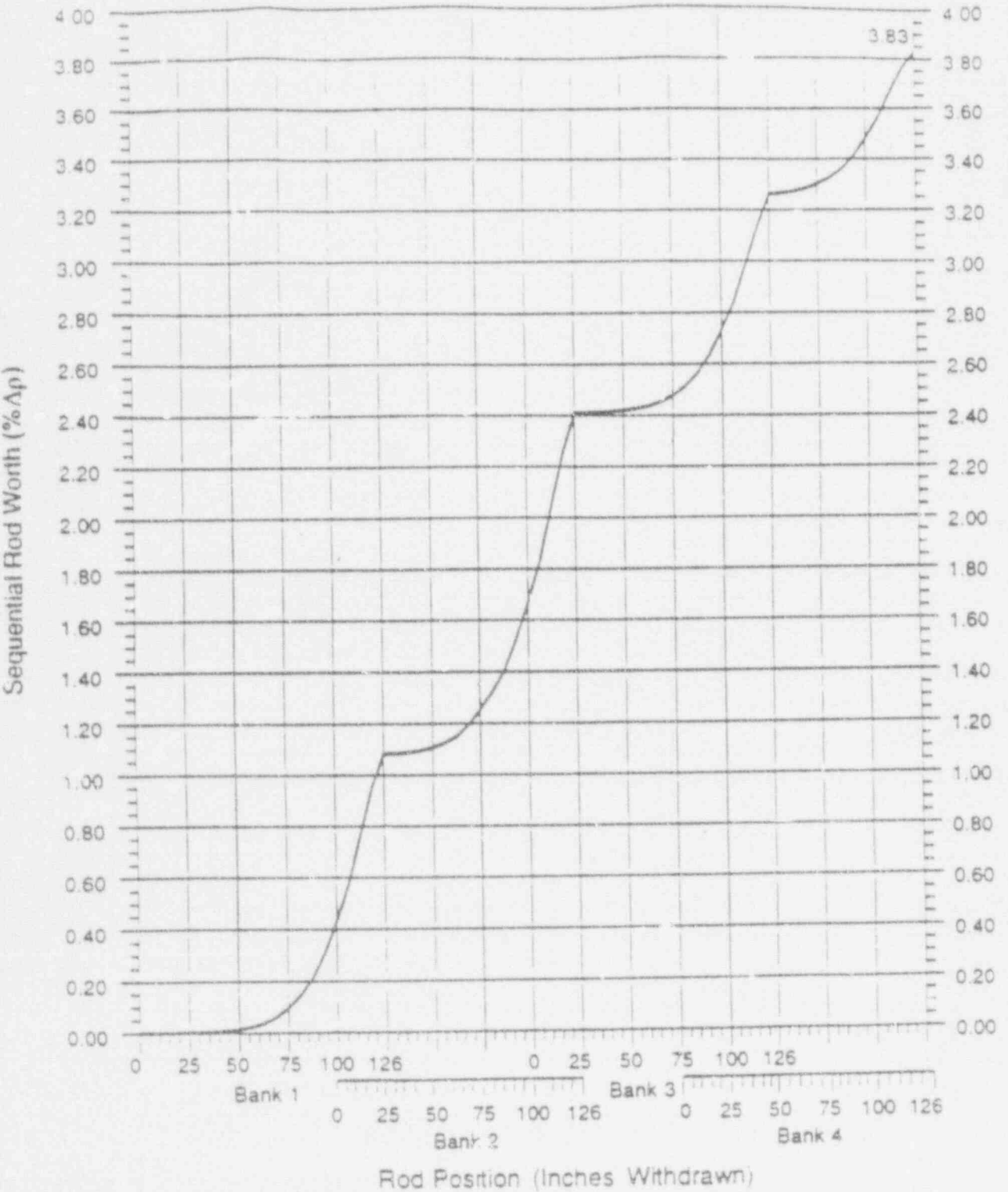


Figure II.B.3.a

Cycle 14 Group 4 Integral Rod Worth

(HZP, 0 MWD/MTU)

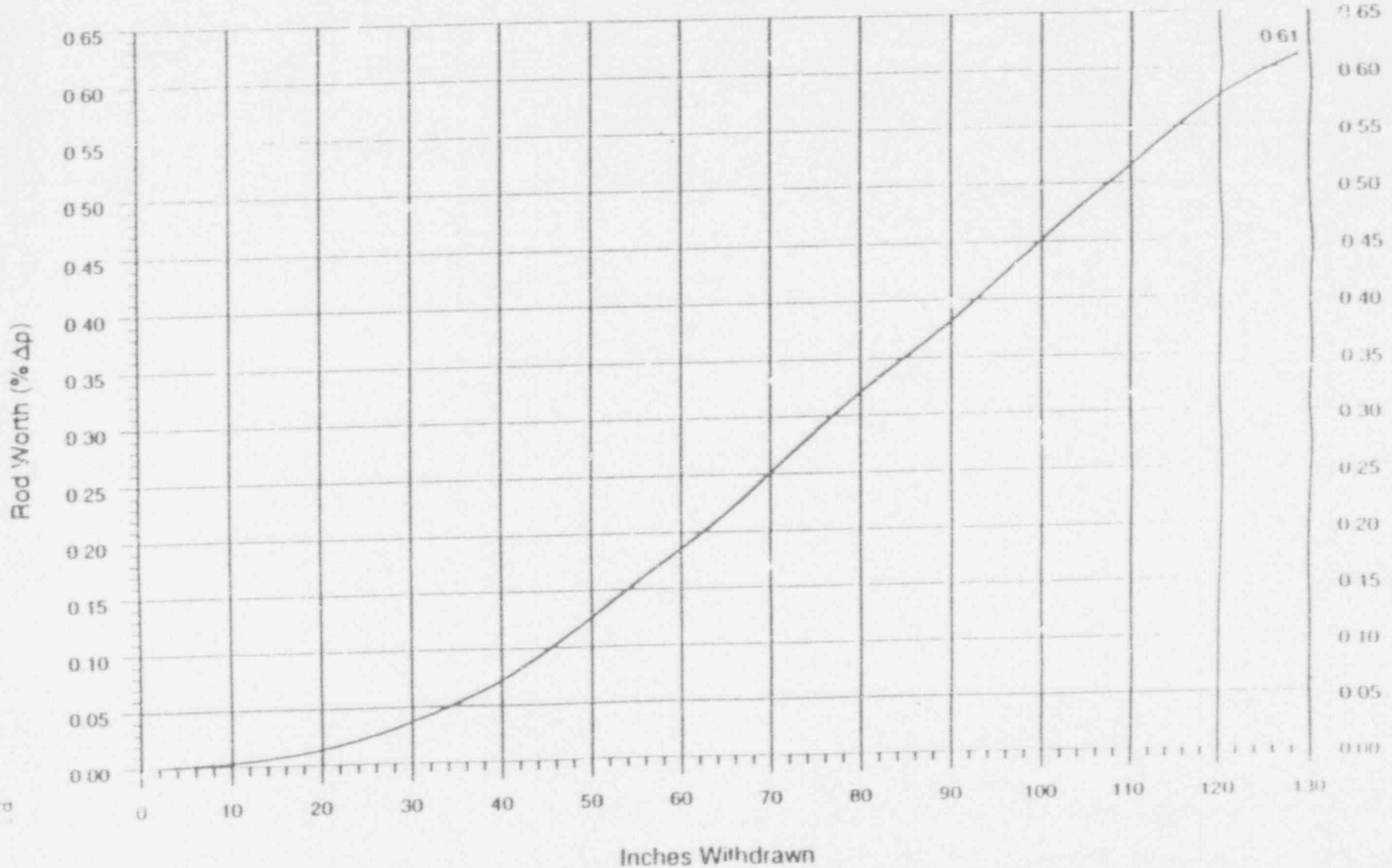


Figure II.B.3.b

Cycle 14 Group 4 Integral Rod Worth

(HZP, 7,000 MWD/MTU)

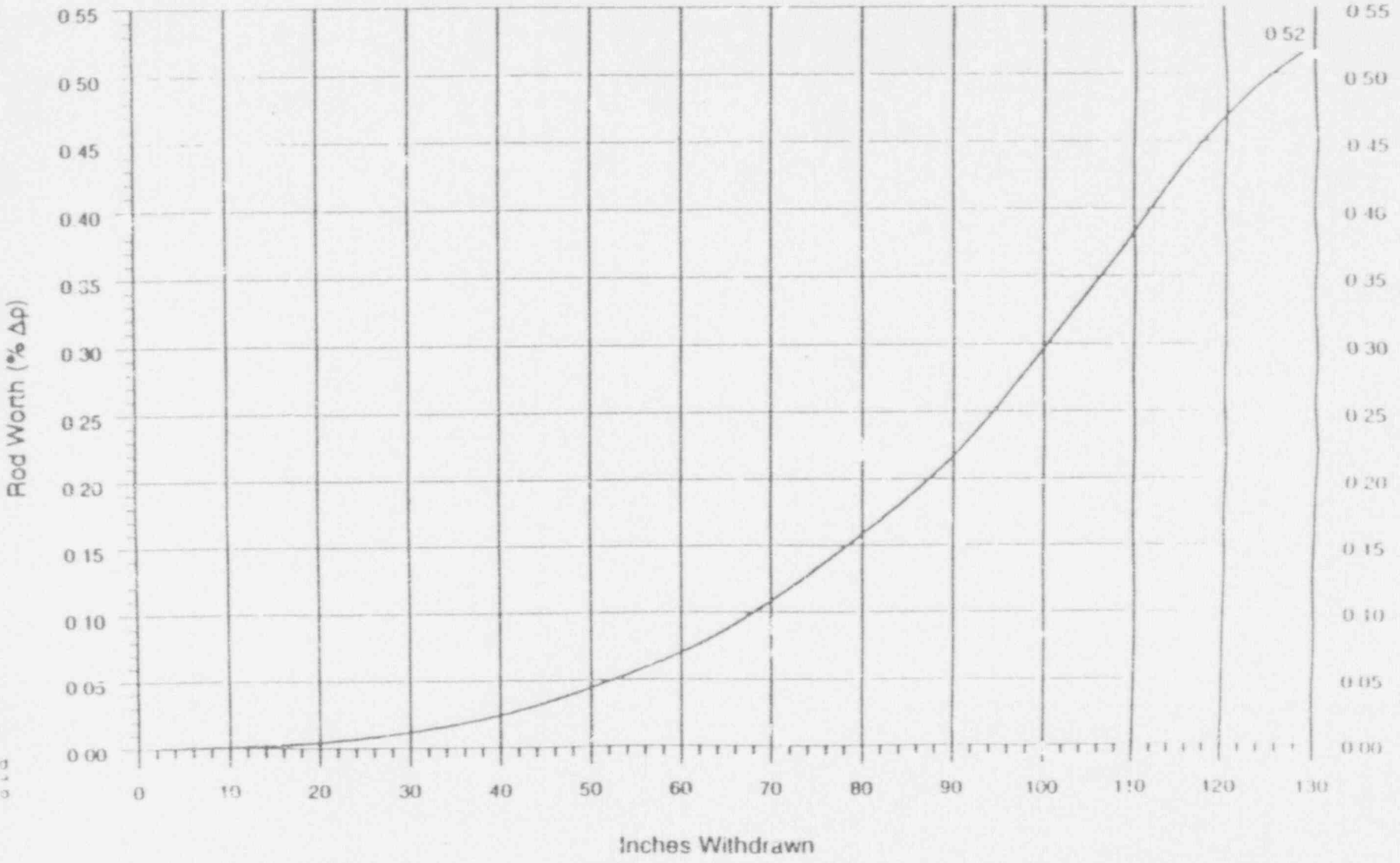


Figure II.B.3.c

Cycle 14 Group 4 Integral Rod Worth

(HZP, 15,000 MWD/MTU)

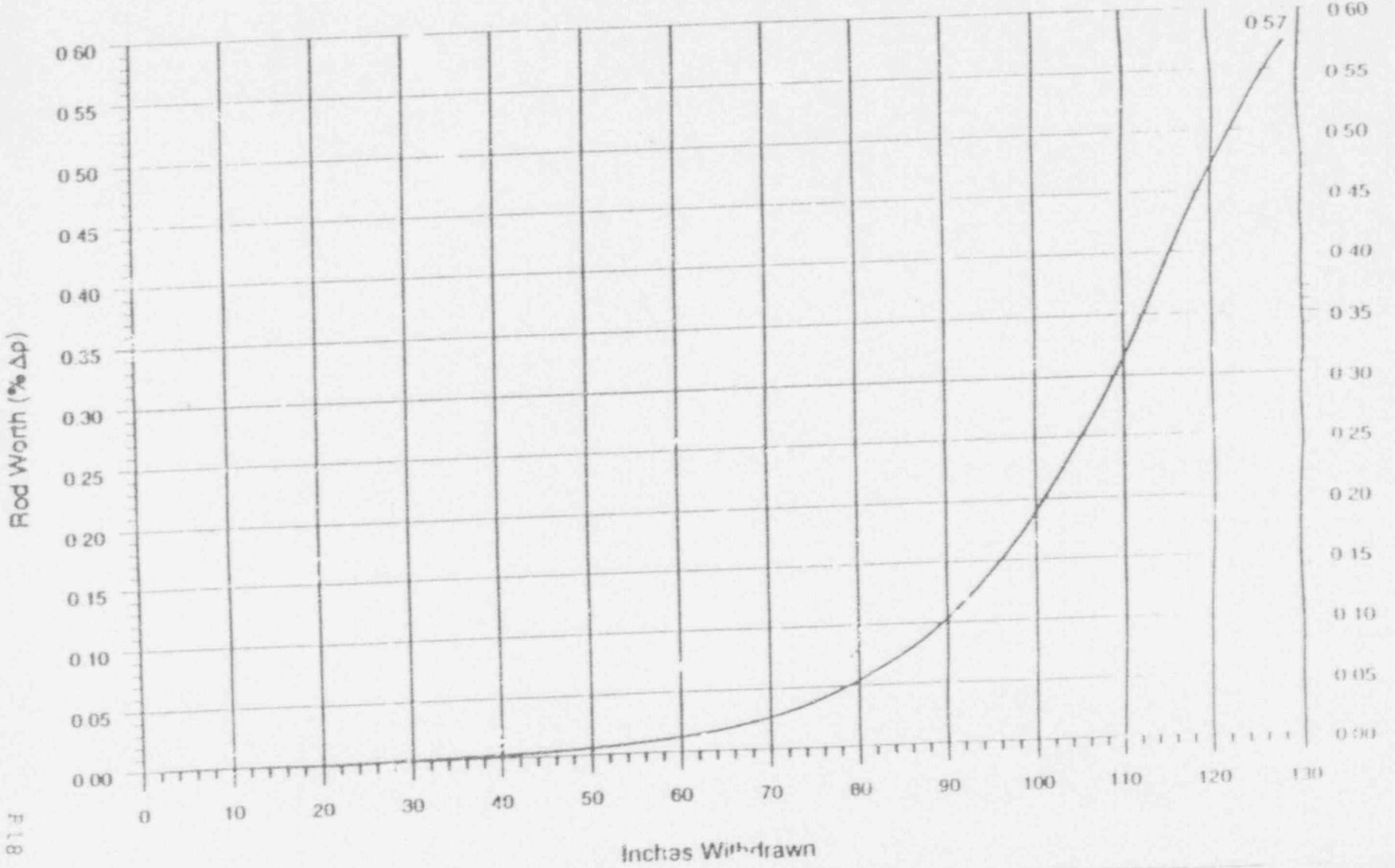


Figure II.C.1

Cycle 14 Excess Reactivity vs Burnup

(ARO, Hot Full Power, Equilibrium Xenon)

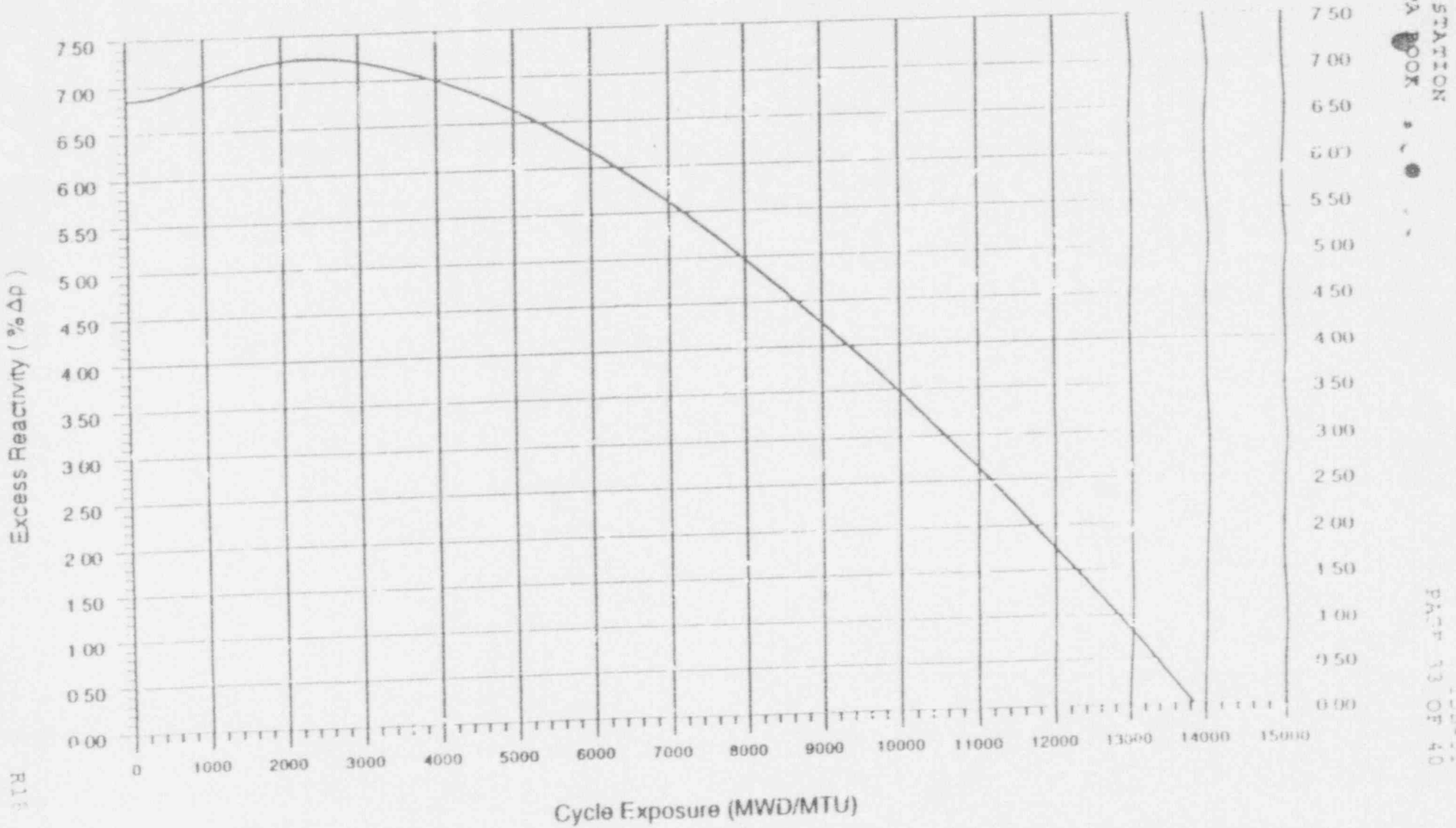


Figure II.C.2.a

Cycle 14 Total Power Defect vs Power
(0 to 6,000 MWD/MTU)

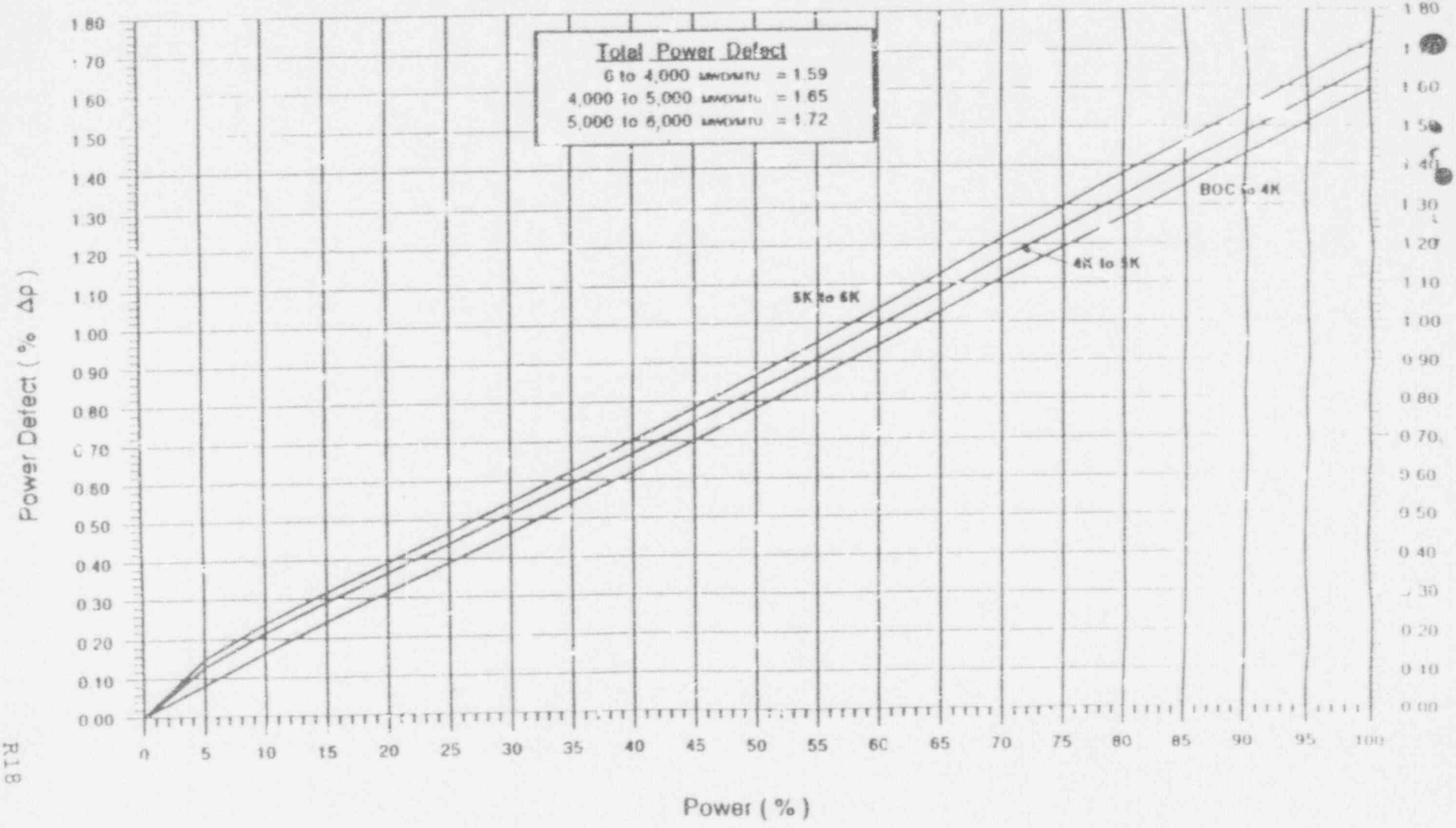


Figure II.C.2.b

Cycle 14 Total Power Defect vs Power

(6,000 to 11,000 MWD/MTU)

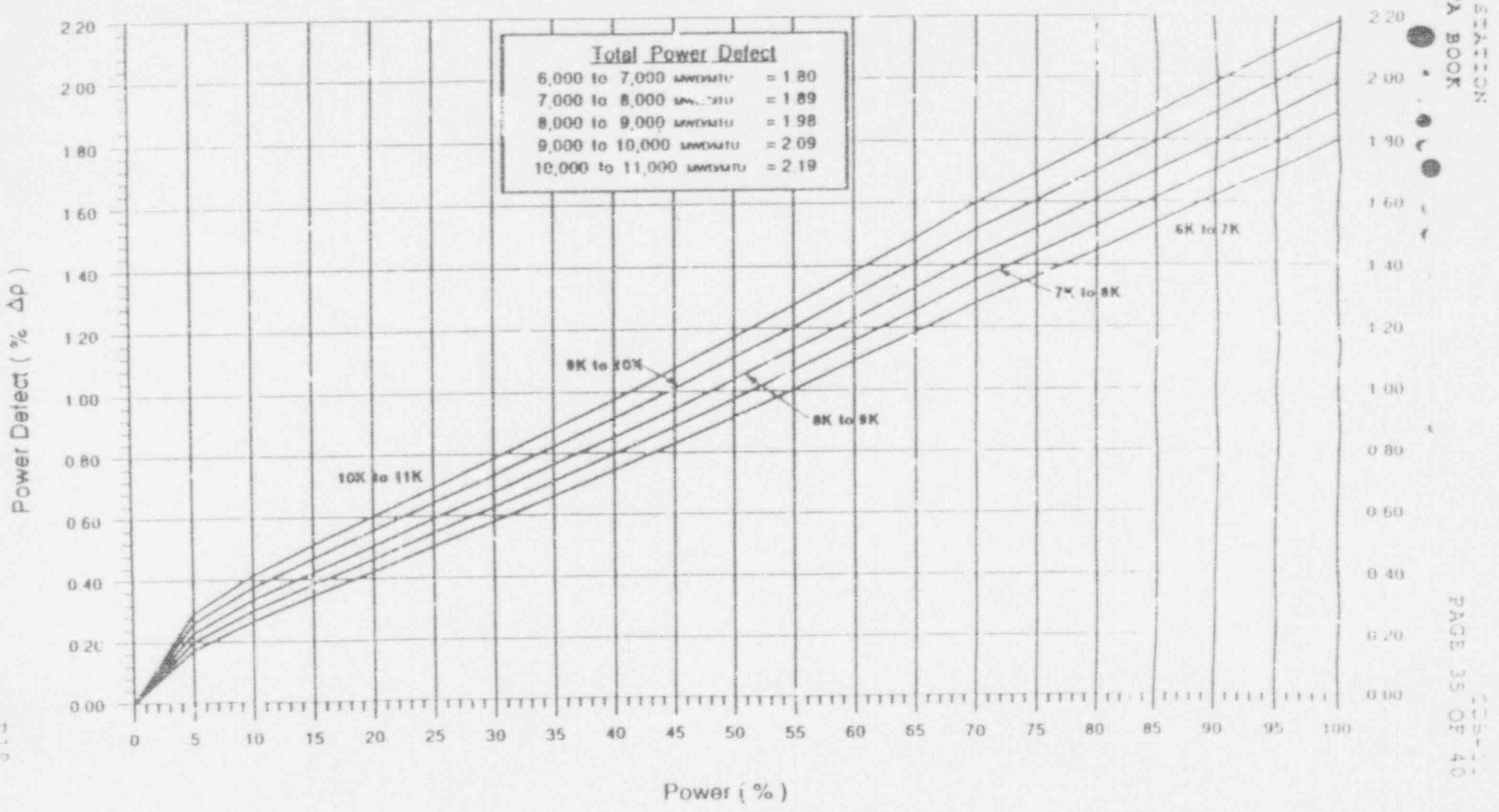


Figure II.C.2.c

Cycle 14 Total Power Defect vs Power
(11,000 to 15,000 MWD/MTU)

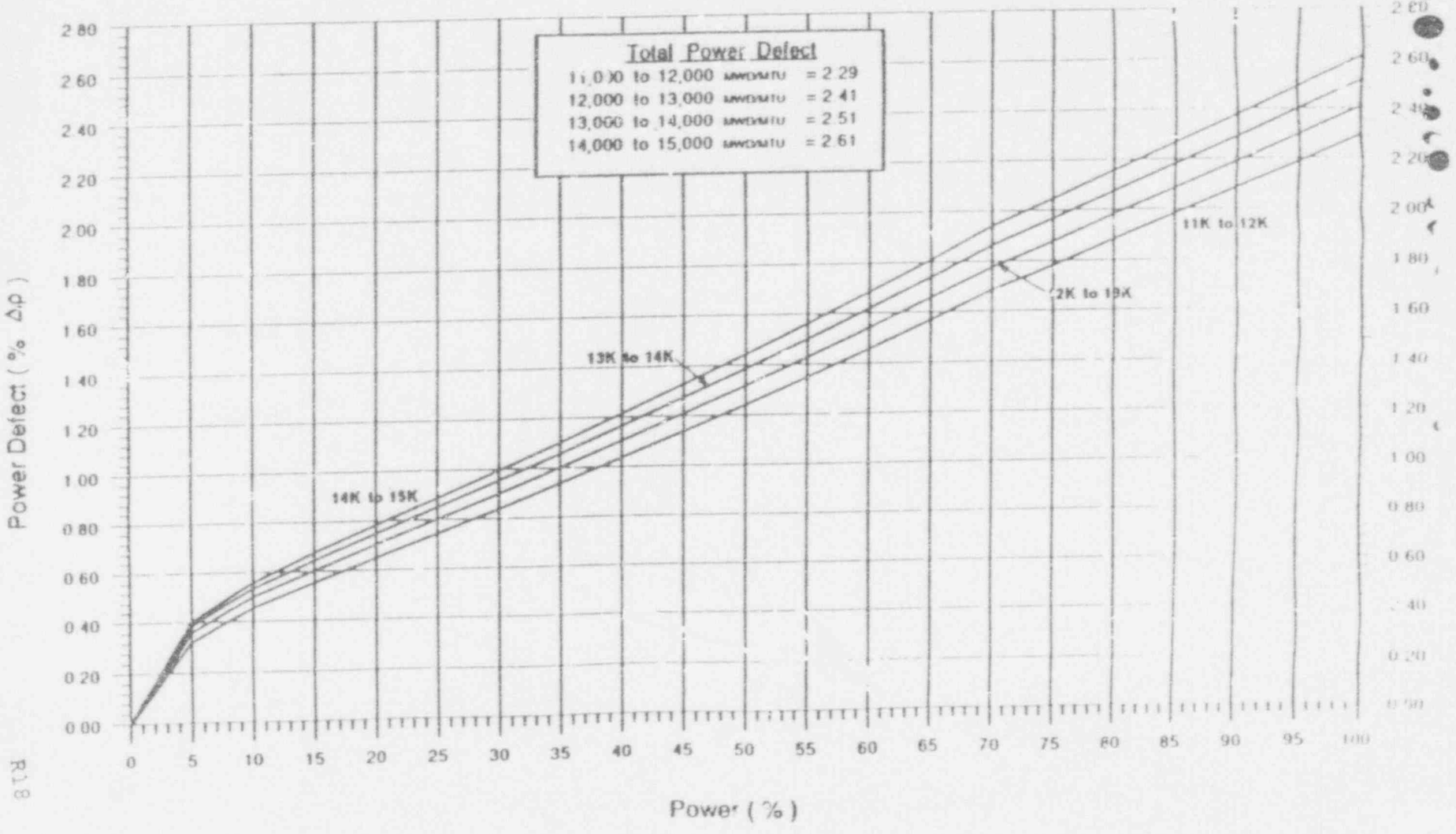


Figure II.C.3

Cycle 14 Moderator Temperature Coefficient vs Burnup

(ARO, HFP, Equilibrium Xenon)

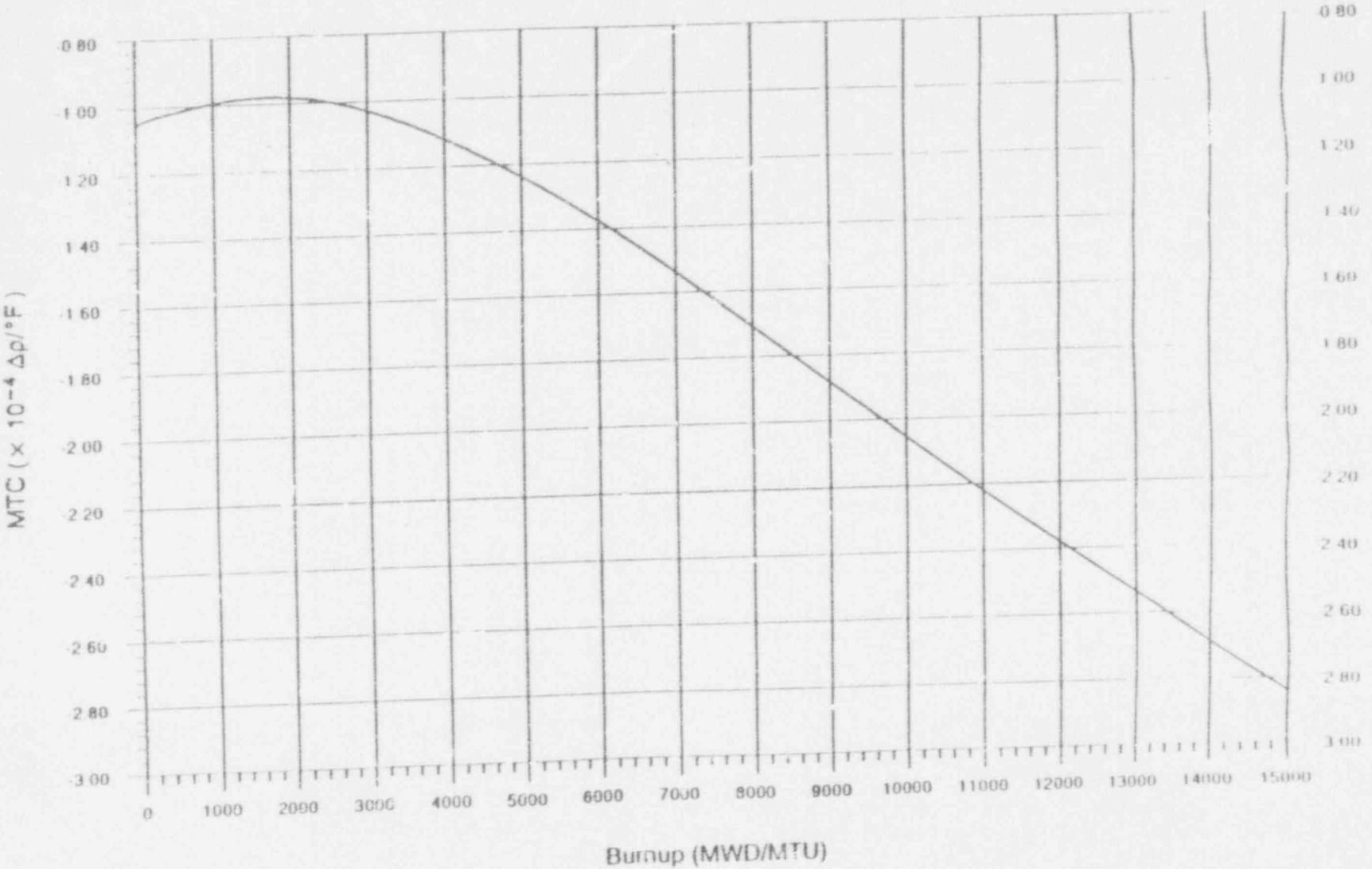


Figure II.D.1.a

Cycle 14 Equilibrium Xenon Reactivity vs Percent Power

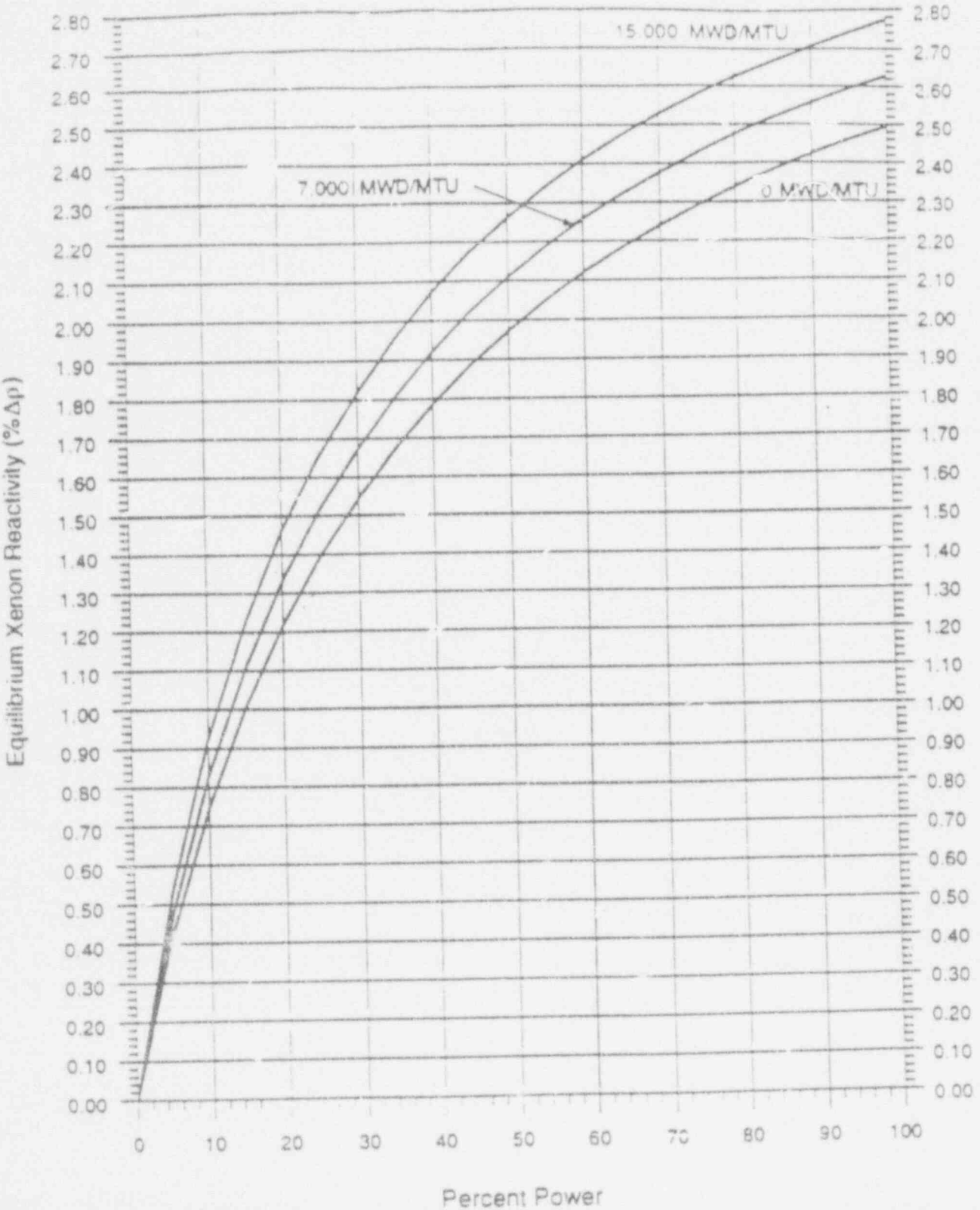


Figure II.D.1.b

Cycle 14 Xenon Reactivity Worth vs Burnup

(All Rods Out, HFP)

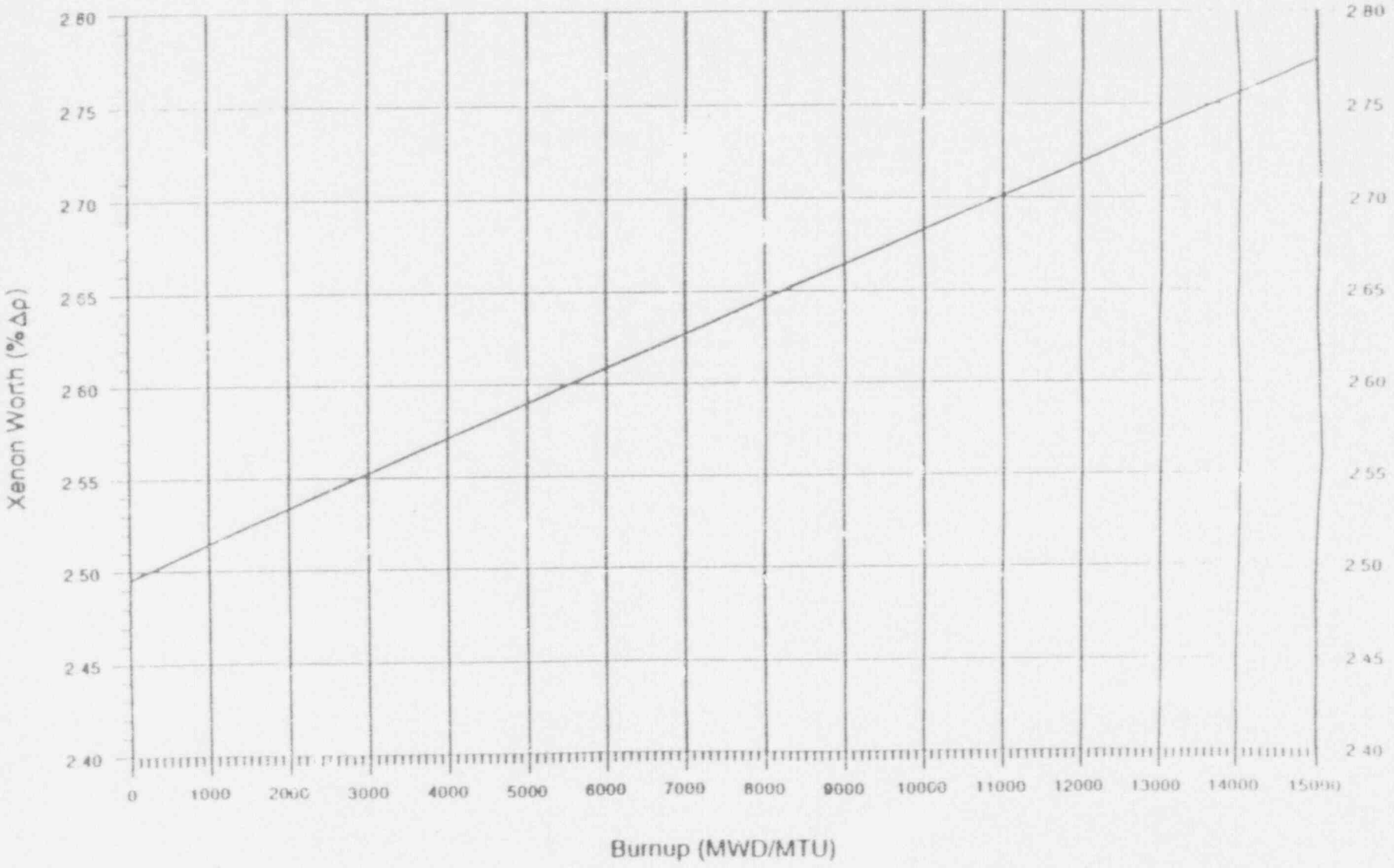
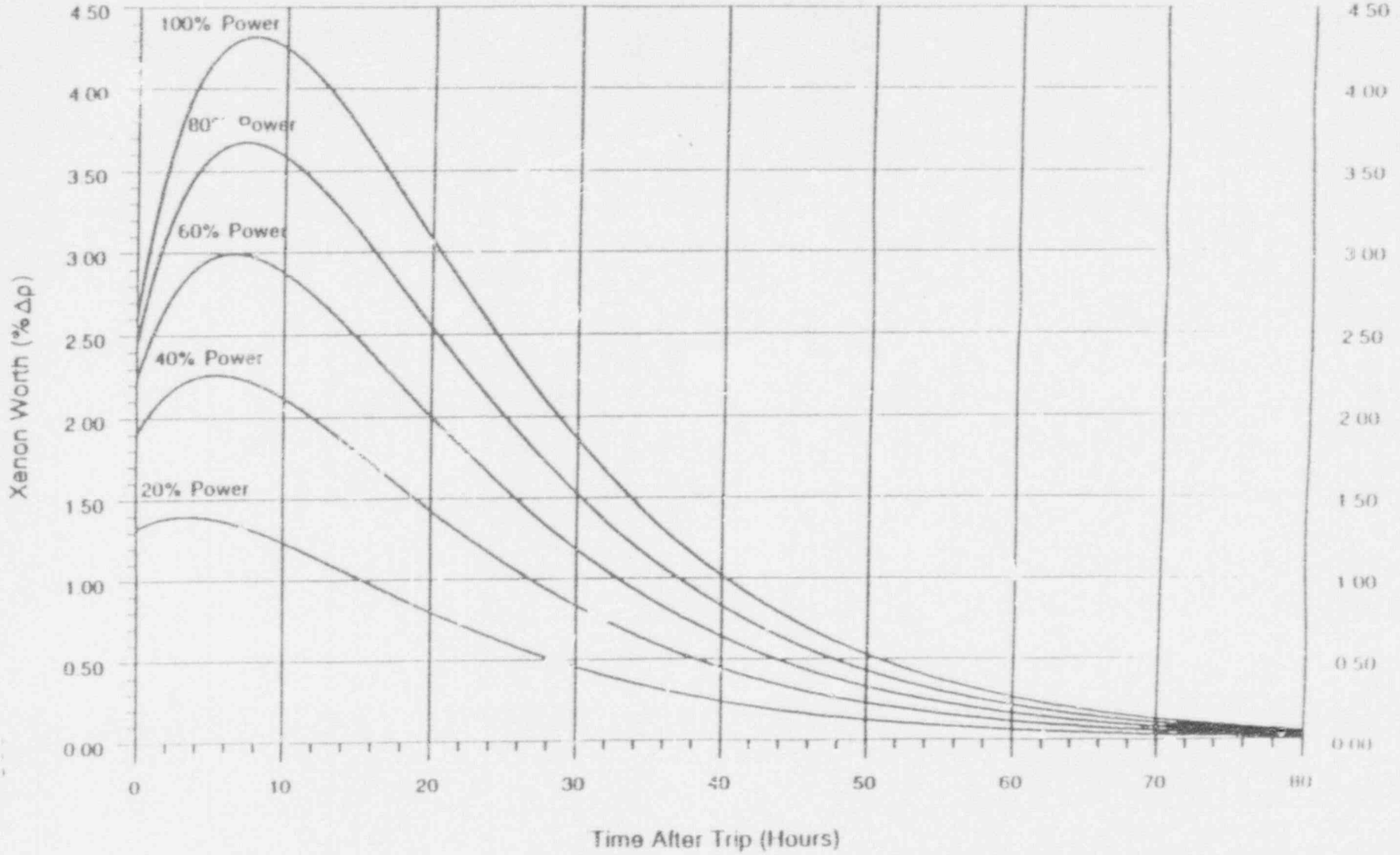


Figure II.D.2

Cycle 14 Xenon Worth After Trip

(7000 MWD/MTU)



U. S. NUCLEAR REGULATORY COMMISSION
SITE SPECIFIC EXAMINATION
SENIOR OPERATOR LICENSE
REGION 4

CANDIDATE'S NAME: _____

FACILITY: FT. Calhoun

REACTOR TYPE: PWR-CE

DATE ADMINISTERED: 97/06/22

INSTRUCTIONS TO CANDIDATE:

Use the answer sheets provided to document your answers. Staple this cover sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires a final grade of at least 80%. Examination papers will be picked up four (4) hours after the examination starts.

TEST VALUE	CANDIDATE'S SCORE	%
98.00 ~~101.00~~		___ % TOTALS

FINAL GRADE

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

_____
Candidate's Signature

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001	a	b	c	d	___
002	a	b	c	d	___
003	a	b	c	d	___
004	a	b	c	d	___
005	a	b	c	d	___
006	a	b	c	d	___
007	a	b	c	d	___
008	a	b	c	d	___
009	a	b	c	d	___
010	a	b	c	d	___
011	a	b	c	d	___
012	a	b	c	d	___
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014	a	b	c	d	___
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024	a	b	c	d	___
025	a	b	c	d	___
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027	a	b	c	d	___
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033	a	b	c	d	___
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038	a	b	c	d	___
039	a	b	c	d	___
040	a	b	c	d	___
041	a	b	c	d	___
042	a	b	c	d	___
043	a	b	c	d	___
044	a	b	c	d	___
045	a	b	c	d	___

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

046 a b c d ___

047 a b c d ___

048 a b c d ___

049 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

050 a b c d ___

051 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

052 a b c d ___

053 a b c d ___

054 a b c d ___

055 a b c d ___

056 a b c d ___

057 a b c d ___

058 a b c d ___

059 a b c d ___

060 a b c d ___

061 a b c d ___

062 a b c d ___

063 a b c d ___

064 a b c d ___

065 a b c d ___

066 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

067 a b c d ___

068 MATCHING

a ___

b ___

MULTIPLE CHOICE

069 a b c d ___

070 a b c d ___

071 a b c d ___

072 a b c d ___

073 a b c d ___

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

074 a b c d ___

075 a b c d ___

076 a b c d ___

077 a b c d ___

078 a b c d ___

079 a b c d ___

080 a b c d ___

081 a b c d ___

082 a b c d ___

083 a b c d ___

084 a b c d ___

085 a b c d ___

086 a b c d ___

087 a b c d ___

088 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

089 a b c d ___

090 a b c d ___

091 a b c d ___

092 a b c d ___

093 a b c d ___

094 MATCHING

a ___

b ___

c ___

d ___

MULTIPLE CHOICE

095 a b c d ___

096 a b c d ___

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

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one applicant at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil ONLY to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. Before you turn in your examination, consecutively number each answer sheet, including any additional pages inserted when writing your answers on the examination question page.

8. Use abbreviations only if they are commonly used in facility literature. Avoid using symbols such as < or > signs to avoid a simple transposition error resulting in an incorrect answer. Write it out.

9. The point value for each question is indicated in parentheses after the question.

10. Show all calculations, methods, or assumptions used to obtain an answer to any short answer questions.

11. Partial credit may be given except on multiple choice questions. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

12. Proportional grading will be applied. Any additional wrong information that is provided may count against you. For example, if a question is worth one point and asks for four responses, each of which is worth 0.25 points, and you give five responses, each of your responses will be worth 0.20 points. If one of your five responses is incorrect, 0.20 will be deducted and your total credit for that question will be 0.80 instead of 1.00 even though you got the four correct answers.

13. If the intent of a question is unclear, ask questions of the examiner only.

14. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition, turn in all scrap paper.

15. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

16. To pass the examination, you must achieve a grade of 80% or greater.

17. There is a time limit of four (4) hours for completion of the examination.

18. When you are done and have turned in your examination, leave the examination area (EXAMINER WILL DEFINE THE AREA). If you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION: 001 (1.00)

A 22 year-old licensed male reactor operator has the following exposure history:

- Current quarterly whole body dose: 250 mrem
- Current yearly whole body dose: 4.5 rem
- Current lifetime whole body dose (including current quarter): 11.25 rem

Assuming his exposure is properly documented, what is the MAXIMUM ADDITIONAL whole body exposure this operator can receive THIS QUARTER and still comply with 10 CFR 20?

a. 500 mrem

b. 750 mrem

c. 1000 mrem

d. 1250 mrem

QUESTION: 002 (1.00)

A Reactor Operator has worked the following hours on the dates indicated:

DATE		HOURS WORKED
05/11/92	-	0800 through 2000
05/12/92	-	0800 through 1800
05/13/92	-	0800 through 2200
05/14/92	-	0800 through 2000
05/15/92	-	0800 through 1600
05/16/92	-	0800 through 2000
05/17/92	-	0800 through 2200

On which of the above dates did this operator FIRST violate the overtime requirements? (S.O. G-52-7 Plant Staff Working Hours, is attached for your reference.)

a. 05/12/92

b. 05/14/92

c. 05/16/92

d. 05/17/92

QUESTION: 003 (1.00)

If the HOST MODCOMP of the ERF Computer System failed and the BACKUP MODCOMP is operable, which of the following states how the system is restored to operation?

a. The backup computer takes over when the on-line computer fails.

b. The operator must enter "TRANSFER, EXECUTE", on the ERF Console in the computer room.

c. The operator must enter "RESTORE, EXECUTE", on the ERF Console in the computer room.

d. The operator must enter "BACKUP, EXECUTE", on the ERF Console in the computer room.

QUESTION: 004 (1.00)

Which ONE of the following is assigned as a Fire Brigade member EXCEPT when the fire causes an evacuation of the Control Room?

a. Equipment Operator Nuclear Aux. Bldg.

b. Auxiliary Operator Nuclear.

c. Security Personnel.

d. Licensed Operator.

QUESTION: 005 (1.00)

Which one of the individuals below is NOT permitted to operate reactor controls under the instruction or supervision of a licensed operator?

a. Equipment Operator Nuclear enrolled in a current license training course to obtain an operator license.

b. A licensed reactor operator who recently failed an NRC administered Senior Reactor Operator upgrade examination.

c. A licensed reactor operator whose license has become inactive per the requirements of 10CFR55.

d. Individual enrolled in a current license training course to obtain an instructor certification.

QUESTION: 006 (1.00)

Which one of the following describes the minimum watchstanding requirements in order to maintain an "Active" license per 10 CFR 55.53, "Conditions of Licenses?"

a. Two 8 hour shifts or one 12 hour shift per calendar month.

b. One 8 hour shift or one 12 hour shift per calendar month.

c. Seven 8 hour shifts or five 12 hour shifts per calendar qua ter.

d. Six 8 hour shifts or four 12 hour shifts per calendar quarter.

QUESTION: 007 (1.00)

MULTIPLE CHOICE

When RCS temperature is greater than 400 degrees F, a minimum of _____ individuals are required for Containment entry.

a. Two

b. Three

c. Four

d. Five

QUESTION: 008 (1.00)

If an operator must perform an action or manipulation which is only done infrequently, the operator is required to review the procedure prior to starting the task or to use a copy of the procedure to perform the required actions. In accordance with Standing Order SO-0-1, "Conduct Of Operations", INFREQUENTLY is defined as which one of the following?

a. Less frequent than once every 3 days.

b. Less frequent than once every 7 days.

c. Less frequent than once every two weeks.

d. Less frequent than once every month.

QUESTION: 009 (1.00)

Which ONE of the following should be commenced only AFTER on-coming personnel have assumed the shift?

a. A Pre-Shift briefing for on-coming personnel.

b. Sign the Licensed Operator Shift Turnover Log.

c. Review of surveillance tests or special tests in progress.

d. Review items affecting plant operations By the on-coming and off-going Licensed Operators

Question deleted

QUESTION: 010 (1.00)

In the event of a computer log typewriter failure, parameters which require recording must be logged manually. Which ONE of the following states when this manual recording should be accomplished?

a. Within one hour of the failure and every hour after that.

b. Within two hours of the failure and every hour after that.

c. Within two hours of the failure and every two hours after that.

d. Within three hours of the failure and every hour after that.

QUESTION: 011 (1.00)

An operator assigned to conduct an independent verification of a tag out must be at least qualified to perform which ONE of the following duties?

a. Licensed Operator

b. Auxiliary Operator Nuclear

c. Equipment Operator Nuclear Auxiliary

d. Equipment Operator Nuclear Turbine

QUESTION: 012 (1.00)

The following indications on the Power Range Nuclear Instrumentation for Channel A are observed:

Upper Detector --- 33%
Lower Detector --- 27%

Which of the following is the Channel A ASI?

a. +0.10

b. +0.06

c. -0.06

d. -0.10

QUESTION: 013 (1.00)

Which of the following control functions or interlocks are provided by the Secondary CEA Position Indication System [SCEAPIS]?

a. Rod Block, Upper Electrical Limit, and Lower Electrical Limit.

b. Rod Withdrawal Prohibit, Regulating Group Withdrawal Prohibit, and Shutdown Group Insertion Permissive.

c. Rod Block, Regulating Group Withdrawal Prohibit, and Shutdown Group Insertion Permissive.

d. Rod Withdrawal Prohibit, Rod Rundown, and Control Rod Sequencing.

QUESTION: 014 (1.00)

If RCS flow is reading 76 on the meter located on CB-3 in the Control Room, which of the following are the units of measurement that are being indicated on this meter?

a. Flow rate in pounds mass per hour [lbm/hr].

b. Flow rate in gallons per minute [gpm].

c. Flow rate as a percent of full flow [%].

d. Differential pressure across the Steam Generator in pounds per square inch differential [psid].

QUESTION: 015 (1.00)

Given the following plant conditions:

- Reactor power level --- 100%
- RCS pressure --- 2160 psia
- RCP seal leakoff --- 1 gpm per pump
- VCT pressure --- 40 psia

If an RCP first stage seal fails, which of the following describes the expected leakoff flow rate and the resultant pressure drop across each operable seal?

a. 1.5 gpm and 1060 psid.

b. 1.2 gpm and 1060 psid.

c. 1.2 gpm and 1080 psid.

d. 1.5 gpm and 1080 psid.

QUESTION: 016 (1.00)

If letdown flow exceeds 155 gpm as sensed by FIC-212 which is located downstream of the Letdown Heat Exchanger [LHX], then Letdown Stop Valve [HCV-204] actuates and isolates flow in the letdown line. The signal from FIC-212 is designed to provide a backup s[illegible]ld which of the following signals fail to function?

a. The 550 psig signal from PIC-24[illegible] located upstream of the LHX.

b. A 550 psig signal from PIC-243 located upstream of the LHX.

c. A 190 psig signal from PIC-244 located downstream of the LHX.

d. A 190 psig signal from PIC-210 located downstream of the LHX.

QUESTION: 017 (1.00)

Which of the following describes the operation of the VCT Outlet Valve [LCV-218-2] and the Charging Pumps Suction To SIRWT Valve [LCV-218-3]?

a. When VCT level as sensed by LT-219 decreases to 6% or less, both LCV-218-2 and LCV-218-3 receive a close signal.

b. When VCT level as sensed by LCS-218 decreases to 3.2% or less, LCV-218-2 and LCV-218-3 both receive an open signal.

c. A Safety Injection Actuation Signal will open LCV-218-3 and LCV-218-2 will remain open.

d. A Safety Injection Actuation Signal will close LCV-218-2 and LCV-218-3 will remain closed.

QUESTION: 018 (1.00)

In the event of a large break LOCA, which ONE of the following relays MUST actuate to automatically open the CCW Heat Exchanger inlet and outlet valves?

a. SIAS auxiliary relays.

b. CSAS lockout relays.

c. PPLS lockout relays.

d. CPHS lockout relays.

QUESTION: 019 (1.00)

Which of the following will cause the Power Range Safety Channel "High Voltage" bistable to trip?

a. A 15 VDC signal is applied to the bistable.

b. "Zero-Operate-Calibrate" switch in the "Calibrate" position.

c. Sub-channel linear amplifier "Test Switch" in the OFF position.

d. Detector High Voltage power supply decreases by 10 VDC.

QUESTION: 020 (1.00)

Which of the following describes the design temperature range for the In-Core Thermocouples?

a. 32 degrees F to 1200 degrees F.

b. 32 degrees F to 2300 degrees F.

c. 100 degrees F to 1200 degrees F.

d. 100 degrees F to 2800 degrees F.

QUESTION: 021 (1.00)

Which of the following operations is initiated by a Containment Isolation Actuation Signal?

a. Opens the Cooling and Filtering Unit face dampers.

b. Opens the Cooling and Filtering Unit bypass dampers.

c. Opens the CCW valves to all unit cooling coils.

d. Starts the Containment Air Cooling fans.

QUESTION: 022 (1.00)

With the plant at 100% reactor power, which of the following describes the operation of the Condensate Recirculation Valve [FCV-1172] and its effect on plant operations? Assume no operator action.

a. FCV-1172 fails open on a loss of air, which could result in a plant trip.

b. FCV-1172 fails closed on loss of air, which could result in a plant trip.

c. FCV-1172 fails open on a loss of air, but the backup recirculation path will maintain the plant on line.

d. FCV-1172 fails closed on loss of air, but a plant trip is avoided since interlocks will cause the Condensate Makeup Valve [LCV-1190] to also close.

QUESTION: 023 (1.00)

If a main feed pump motor has tripped due to phase differential, which of the following describes how the trip condition is cleared?

a. Take the Control Room switch on CB-1 to the "OFF" [green flag] position.

b. The phase differential reset flag at the breaker must be manually reset.

c. The phase differential trip will automatically reset when the condition causing the trip has cleared.

d. The lock-out relay on Control Room panel AI-12 must be manually reset.

QUESTION: 024 (1.00)

The LOCAL/REMOTE switch on AI-179 is in the LOCAL position. Which of the following describes the response of the Auxiliary Feedwater System to an AFAS initiation?

a. AFW Control Valves [HCV-1107A & 1108A] will open, but will not close when S/G level is restored to 60% WR.

b. Only the Turbine Driven AFW Pump FW-10 will start.

c. Only the Motor Driven AFW Pump FW-6 will start.

d. Both AFW Pumps will start and all four AFW Control Valves [HCV-1107A,B & 1108A,B] will open.

QUESTION: 025 (1.00)

Which of the following automatic actions will occur if a high radiation alarm is actuated on RM-055 or RM-055A?

a. Overboard Discharge Flow Control Valves [HCV-691 & 692] will close and the Monitor Tank Pumps trip.

b. High Radiation alarm on AI-100 actuates and Monitor Tank Inlet Valves [HCV-672 & 678] close.

c. Reactor Coolant Drain Tank Pumps stop and Overboard Discharge Flow Control Valves [HCV-691 & 692] close.

d. Monitor Tank Inlet Valves [HCV-672 & 678] close and Monitor Tank Pumps trip.

QUESTION: 026 (1.00)

The Gas Decay Tank is being released via the plant stack when Ventilation Air Particulate Monitor [RM-61] "FLOW FAULT" light actuates and the gas release is terminated. With RM-61 out of service, the gas release may be resumed under which ONE of the following conditions?

a. If both the Ventilation Iodine Monitor [RM-60] and the Ventilation Gas Monitor [RM-62] are in service.

b. If Containment Air Particle Monitor [RM-50] is in service.

c. After reducing gaseous flow discharge rate by at least 30 SCFH.

d. After RM-50 and RM-51 are aligned to monitor the stack and actuation setpoints have been reset

QUESTION: 027 (1.00)

If the "B" Steam Generator Blowdown Monitor [RM-54B] alarms high, which of the following describes the automatic actions that will occur?

a. Blowdown and blowdown sample flow from only the "B" S/G will isolate.

b. Blowdown and blowdown sample flow from both the "A" and "B" S/Gs will isolate.

c. Only the S/G Blowdown Outside Containment Isolation Valves [HCV-1387B and 1388B] will close.

d. Blowdown Sample Discharge Valve [HCV-2508] diverts the discharge flow path from the raw water system to the radioactive waste disposal system.

QUESTION: 028 (1.00)

Which type of detector is used in most of the plant Area Radiation Monitors?

a. G-M detectors.

b. Ion Chamber detectors.

c. Beta Scintillation detectors.

d. Sodium Iodide detectors.

QUESTION: 029 (1.00)

In the event of an accident, noncondensible gases can be vented from the reactor vessel head using the Reactor Coolant Gas Vent System [RCGVS]. Which ONE of the following describes the flow path for the vented gases?

a. Vented to the Pressurizer Quench Tank only.

b. Vented to the Reactor Coolant Drain Tank only.

c. Vented to the Pressurizer Quench Tank or the Reactor Coolant Drain Tank.

d. Vented to the Pressurizer Quench Tank or Containment Atmosphere.

QUESTION: 030 (1.00)

Which of the following correctly describes the power source for LPSI Pump SI-1B?

a. 4160V Bus 1A3 with normal supply from 161 KV power.

b. 4160V Bus 1A4 with normal supply from 161 KV power.

c. 4160V Bus 1A3 with normal supply from 22 KV power.

d. 4160V Bus 1A4 with normal supply from 22 KV power.

QUESTION: 031 (1.00)

In the event of a loss of power, which ONE of the following will PREVENT the Diesel Generator breakers from automatically closing on their respective 4160V buses?

a. The LPSI pump handswitches are in the AFTER START position.

b. The Raw Water pump circuit breaker is closed.

c. The LPSI pump 69 permissive switches on the switchgear are NOT in the PERMISSIVE [green flag] position.

d. A Recirculation Actuation Signal [RAS] is present and the LPSI pump recirc override keyswitches are in the OVERRIDE position.

QUESTION: 032 (1.00)

Given the following conditions:

Pressurizer Level Selector Switch --- selected to channel X
Pressurizer Level Channel Defeat Switch --- selected to channel X/Y

If Pressurizer Level Sigma Meter LIC-101X fails LOW, which of the following describes how the Pressurizer Level Control System will respond if no operator action is taken?

a. PRESSURIZER LEVEL HI-LO CHANNEL X annunciator alarms and all standby charging pumps start.

b. Letdown flow decreases to minimum flow and both standby charging pumps start.

c. All pressurizer heaters deenergize and the PRESSURIZER LEVEL LO-LO annunciator alarms.

d. Only PRESSURIZER LEVEL LO-LO annunciator alarms.

QUESTION: 033 (1.00)

Key lock switch HC-102-1 for Power Operated Relief Valve [PCV-102-1] has been taken to the OPEN position on CB-1/2/3 and the RED indicating light is ON. Which ONE of the following describes how the indicating light circuit is activated?

a. Movement of the solenoid plunger actuates a limit switch.

b. Movement of the pilot valve lever actuates a limit switch.

c. Contacts in the key lock switch actuate the indicating circuit.

d. Acoustic monitors sense flow noise and actuate the indicating circuit.

QUESTION: 034 (1.00)

If the manual trip pushbutton on CB-4 is the only trip pushbutton actuated, which of the following describes the response of the Reactor Protective System?

a. Opens contacts in the M coil circuit causing two of four RPS breakers to trip on undervoltage.

b. Opens contacts in the M coil circuit causing all four RPS breakers to trip on undervoltage.

c. Opens contacts in the M coil circuit causing all four clutch power supplies to deenergize.

d. Contacts in the RPS breakers undervoltage trip circuits open and trip all four RPS breakers.

QUESTION: 035 (1.00)

Which of the following Engineered Safeguards signals will automatically close Hydrogen Purge Dampers HCV-881 and HCV-882?

a. Ventilation Isolation Actuation Signal [VIAS].

b. Pressurizer Pressure Low Signal [PPL3].

c. Containment Spray Actuation Signal [CSAS].

d. Containment Radiation High Signal [CRHS].

QUESTION: 036 (1.00)

Which of the following describes the operation of the Spent Fuel Pool Cooling System [SFPCS]?

a. SFPCS pumps can be started and stopped locally or in the Control Room, but demineralizer and filter flow can only be read in the Control Room.

b. SFPCS pumps can be started and stopped locally or in the Control Room, but demineralizer and filter flow can only be read locally.

c. SFPCS pumps can only be started and stopped locally and demineralizer and filter flow can only be read locally.

d. SFPCS pumps can only be started and stopped locally, but demineralizer and filter flow can only be read in the Control Room.

QUESTION: 037 (1.00)

Which ONE of the following shutdown signals remain enabled during an emergency start of the Emergency Diesel Generator?

a. Engine overspeed

b. High water temperature

c. Low lube oil pressure

d. High crankcase pressure

QUESTION: 038 (1.00)

Which of the following describes parallel operation of the Emergency Diesel Generators [EDG]?

a. Either EDG may be operated in parallel with the power source which is supplying its respective 1A3 or 1A4 bus.

b. The EDGs can operate in parallel only when buses 1A3 and 1A4 are connected by the cross tie breaker.

c. Interlocks prevent parallel operation of EDG-1 and EDG-2 when connected to their respective 1A3 and 1A4 buses.

d. Only Operating Procedures prevent parallel operation of the EDGs through the 480V buses.

QUESTION: 039 (1.00)

If a spurious trip signal causes the normal supply breaker for safeguards bus 1A3 to open, which of the following is the first action that occurs to restore power to the safeguards bus?

a. EDG-1 emergency starts and loads onto the bus.

b. The normal supply breaker performs an automatic reclose after 0.5 seconds.

c. The cross tie breaker between safeguard buses 1A3 and 1A4 automatically closes.

d. A fast transfer to the alternate power supply for bus 1A3 occurs.

QUESTION: 040 (1.00)

MULTIPLE CHOICE

The Main Steam Isolation Valve [MSIV] disk is held in the open position by ____(1)____ pressure acting against ____(2)____ pressure trying to close the valve.

a. (1) hydraulic (2) spring

b. (1) hydraulic (2) steam

c. (1) pneumatic (2) spring

d. (1) spring (2) steam

QUESTION: 041 (1.00)

The Jockey Pump used to pressurize the fire main is supplied with water from which of the following sources?

a. Raw water system

b. Potable water system

c. Screen wash system

d. Intake structure bays

QUESTION: 042 (1.00)

Shutdown cooling has been in operation for the past 8 hours when shutdown cooling flow as read on FIC-326 decreases to 900 gpm. Which ONE of the following describes the plant response to this condition?

a. SDHX Bypass Valve [FCV-326] goes to the closed position.

b. SDHX Bypass Valve [FCV-326] goes to the full open position.

c. Hot Leg Suction Valves [HCV-347 and 348] go to the closed position.

d. SHUTDOWN COOLING FLOW LOW alarm is the ONLY plant response actuated.

QUESTION: 043 (1.00)

Given the following Quench Tank conditions:

- Quench Tank Pressure --- 9 psig
- Quench Tank Temperature --- 118 degrees F
- Quench Tank Level --- 45%

Which ONE of the following actions should be taken to restore normal operating conditions in the Quench Tank in accordance with OI-RC-6, "Pressurizer Quench Tank Normal Operation?"

a. Raise Nitrogen pressure.

b. Vent the Quench Tank to the Vent Header.

c. Add Demineralized Water while draining to the RCDT.

d. Add Demineralized Water while venting to the Vent Header.

QUESTION: 044 (1.00)

If a Component Cooling Water/Raw Water [CCW/RW] interface valve is NOT handjacked shut, which ONE of the following would cause this valve to open?

a. Primary solenoid energizes; secondary solenoid energizes.

b. Primary solenoid de-energizes; secondary solenoid de-energizes.

c. Primary solenoid de-energizes; secondary solenoid energizes.

d. Primary solenoid energizes; secondary solenoid de-energizes.

QUESTION: 045 (1.00)

If one Raw Water Pump is operating and a rupture develops at the discharge of the pump, which of the following describes the effect on pump operation?

a. Total dynamic head decreases and flow increases.

b. Total dynamic head increases and flow increases.

c. Total dynamic head decreases and flow decreases.

d. Total dynamic head increases and flow decreases.

QUESTION: 046 (1.00)

With the plant at 80% power, which one of the following indicates a condition requiring emergency boration according to AOP-3 (Emergency Boration)?

a. T-cold is decreasing; HCV-1040 (Atmosphere Steam Dump) won't close

b. Loss of Primary CEA Position Indication system

c. Receipt of a ROD POSITION DEVIATION LOW-LOW LIMIT alarm

d. Group 4 CEAs 15 inches below power dependent insertion limit

QUESTION: 047 (1.00)

Which one of the following process radiation monitors, if alarming, will NOT cause a PROCESS RADIATION HIGH OR TROUBLE alarm?

a. Condenser Off-gas (RM-057)

b. Containment Air Particulate (RM-050)

c. Component Cooling Water (RM-053)

d. Waste Disposal Liquid Effluent (RM-055A)

QUESTION: 048 (1.00)

Given the following plant conditions with a leaking pressurizer PORV:

- Pressurizer pressure 1200 psia
- Quench tank pressure 5 psig
- Quench tank temperature 90 F.
- Reactor is shutdown

Assume ambient heat losses are negligible and the quality of the steam in the pressurizer steam space is 100%.

Which one of the following PORV downstream temperatures would result from the leaking pressurizer PORV?

a. 228 F

b. 258 F

c. 288 F

d. 318 F

QUESTION: 049 (2.00)

The reactor is operating at full power conditions when a complete loss of instrument air header pressure occurs. Match each valve in Column A with the IMMEDIATE position/condition in Column B caused by the loss of air pressure. (0.5 each)

(Numbers from column B may be used once, more than once, or not at all, but only a single answer may occupy each answer space.)

Column A (COMPONENT)	Column B (CONDITION/POSITION)
____ a. AFW Containment Isolation valves (HCV-1107A/8A)	1. Fail as is/flow cannot change
____ b. CCW to RCP Seal & [illegible] Oil Coolers (HCV-438B)	2. Fail closed/flow stopped
____ c. Letdown Flow Control Valves (LCV-101-1/2)	3. Fail open/flow maximum
____ d. RCP Controlled Bleed-Off to VCT (HCV-241)	4. No immediate effect/system functions normally

QUESTION: 050 (1.00)

Which one of the following events is covered by AOP-8 (Fuel Handling Incident)?

a. A new fuel assembly is dropped while being loaded into the fuel elevator.

b. The reactor goes critical while an irradiated fuel assembly is being reloaded into the core.

c. A spent fuel assembly is damaged while being inserted into the spent fuel pool rack.

d. Water level in the refueling cavity starts dropping rapidly during refueling operations.

QUESTION: 051 (2.00)

The unit is operating at full power. Match each of the following RCP seal pressure (psia) conditions in column A to the applicable seal status in column B. (0.5 each)

(Numbers in column B may be used once, more than once, or not at all, but only a single answer may occupy each answer space.)

Column A
(PRESSURE CONDITIONS - PSIA)

	RCS	MIDDLE SEAL	UPPER SEAL	VCT
_____ a.	2100	2050	2000	50
_____ b.	2100	2080	1050	40
_____ c.	2100	1050	50	40
_____ d.	2100	1060	1030	45

Column B
(SEAL STATUS)

1. Normal
2. Lower Seal Failure
3. Middle Seal Failure
4. Upper Seal Failure
5. Lower and Middle Seal Failure
6. Middle and Upper Seal Failure

QUESTION: 052 (1.00)

Given the following plant conditions:

- Small break LOCA has occurred
- Pressurizer pressure is stable at 1400 psia
- Containment temperature is 187 F
- Actual pressurizer level is 50%

Select the combination below that fills in the following blanks.

The low pressurizer pressure tends to make the indicated pressurizer level __(1)__ than actual; the high containment temperature tends to make the indicated pressurizer level __(2)__ than actual.

a. (1) Lower; (2) Lower

b. (1) Lower; (2) Higher

c. (1) Higher; (2) Lower

d. (1) Higher; (2) Higher

QUESTION: 053 (1.00)

Conditions have occurred such that the 13.8KV/480V transformer must supply 480V Bus 1B3C. Which of the following states the actions necessary to connect the 13.8KV source to 480V Bus 1B3C using breaker 1B3C-4?

a. Lockout relay 86/1B3C must be reset and Bus 1B3C must be stripped of all loads before breaker 1B3C-4 can be closed.

b. Normal supply breaker 1B-3C to Bus 1B3C must be opened and breaker 1B3C-4 must be closed.

c. Normal supply breaker 1B-3C to Bus 1B3C must be opened and racked out before breaker 1B3C-4 can be closed.

d. Lockout relay 86/1B3C must be reset for the autoclosure circuit to close breaker 1B3C-4 when no voltage is sensed on Bus 1B3C.

QUESTION: 054 (1.00)

Which of the following statements is correct concerning the relative value of the Shutdown Margin (SDM) after a reactor trip from 1% equilibrium power versus from 100% equilibrium power?

(Assume pre-trip CEA positions are the same for both cases, and NO post-trip operator actions are taken which would affect SDM.)

a. The greater SDM would exist after the 1% power trip

b. The greater SDM would exist after the 100% power trip

c. The SDM would be the same for both trips

d. After 72 hours (Xenon-free) both SDMs would be the same

QUESTION: 055 (1.00)

If RCS pressure drops below steam generator pressure during a loss of coolant accident, it indicates that:

a. The ECCS flow is inadequate to remove decay heat.

b. The main steam isolation valves have been closed.

c. The break flow is removing all core decay heat.

d. Heat removal by reflux boiling is taking place.

QUESTION: 056 (1.00)

Which one of the following describes the consequences of late initiation of once-through core cooling during conditions where it is required?

a. The flow rate through the PORVs may no longer be adequate to remove decay heat, which may lead to core damage

b. The decay heat level may not be adequate to support sufficient natural circulation flow to prevent core damage

c. The HPSI flow rate may no longer be adequate to maintain RCS inventory high enough to prevent core damage

d. The increase in RCS temperatures may increase hydraulic forces on the fuel assemblies, which may lead to core damage

QUESTION: 057 (1.00)

Which one of the following RCS pressure-temperature combinations would require the tripping of all RCPs following a reactor trip?

A copy of EOP Attachment 2 is provided for reference.

	Pressure	CET Avg	T-hot	T-cold
a.	900 psia	510 F	505 F	495 F
b.	800 psia	485 F	480 F	480 F
c.	700 psia	480 F	485 F	480 F
d.	600 psia	455 F	445 F	445 F

QUESTION: 058 (1.00)

Which of the following states the RCS pressure at which one RCP in each loop should be tripped during the performance of EOP-00 (Standard Post-Trip Actions), and the location of the small-break LOCA for which this RCP trip strategy is designed?

a. 1350 psia; cold leg

b. 1350 psia; hot leg

c. 1600 psia; cold leg

d. 1600 psia; hot leg

QUESTION: 059 (1.00)

The plant is initially at 60% power and no operator actions are in progress. The control room operators note that the indicated ASI value is moving in the negative direction. Which of the following is the most probable cause of the ASI change?

a. A steam generator safety valve popping open

b. A dropped shutdown group CEA

c. An unplanned RCS boron dilution

d. An uncontrolled CEA withdrawal

QUESTION: 060 (1.00)

In the hierarchy of Critical Safety Functions (CSFs), which CSF ranks directly behind Reactivity Control in the priority order?

a. RCS Inventory

b. RCS Pressure Control

c. Containment Isolation

d. Maintenance of Vital Auxiliaries

QUESTION: 061 (1.00)

Which of the following describes the automatic action(s) that result(s) from a HIGH ACTIVITY alarm on RM-057 (Condenser Off-Gas)?

a. Off-gas diverts through VA-82 (Containment H2 Purge Filter), AND RCV-978 (6th stage extraction to Aux Steam) closes.

b. Off-gas diverts through VA-82 (Containment H2 Purge Filter).

c. RCV-978 (6th stage extraction to Aux Steam) closes.

d. NO automatic action(s) result. ALL required action(s) are MANUAL manipulations.

QUESTION: 062 (1.00)

Which of the following parameter trends is INCONSISTENT with the indications expected for a void in the RCS during natural circulation cooling?

a. RCS pressure is remaining steauy near 800 psia while Aux Spray is flowing to the pressurizer.

b. RCS pressure is remaining steady near 800 psia while RVLMS indicates 83% with slowly decreasing pressurizer level.

c. Pressurizer level decreases rapidly from 30% to 5% while the RCS is depressurized with Aux Spray.

d. Pressurizer level increases rapidly from 5% to 30% while Aux Spray is flowing to the pressurizer.

QUESTION: 063 (1.00)

If SG water level drops to 20% (Narrow Range) after a reactor trip, which of the following is the preferred method of feeding that SG with AFW to minimize the possibility of water hammer?

a. Via AFW nozzles using FW-6 full flow

b. Via AFW nozzles at 150 gpm

c. Via Feed Ring using FW-6 full flow

d. Via Feed Ring at 150 gpm

QUESTION: 064 (1.00)

Current plant conditions:

The reactor has been tripped
All RCPs were tripped 30 minutes ago
T-hot is steady at 540 degrees F

Which of the following RCS parameters indicates that inadequate core cooling/inadequate natural circulation flow exists for the above conditions?

a. T-cold is 510 degrees F and steady.

b. T-cold is 505 degrees F and decreasing.

c. CET average is 545 degrees F and steady.

d. Pressure is 1100 psia and decreasing.

QUESTION: 065 (1.00)

Given the following plant conditions:

- 100% reactor power
- Boron concentration = 775 ppm
- CEAs in all groups are fully withdrawn
- Current burnup = 1000 MWD/MTU
- CEA 40 in Group 4 has been determined to be stuck out (NOT trippable).

Which of the following is the Total Instantaneous Shutdown Margin for the conditions given above? (References are provided)

a. + 2.26 %

b. - 4.34 %

c. - 4.78 %

d. - 5.12 %

QUESTION: 066 (2.00)

For each automatic action in column A, select the main condenser vacuum setpoint at which the action should occur from column B. (0.5 each)

(Numbers in column B may be used once, more than once, or not at all, but only a single number may occupy each answer space.)

Column A (AUTOMATIC ACTIONS)	Column B (VACUUM SETPOINTS)
_____a. Turbine Trip	1. 25 inches Hg
_____b. Steam dump and bypass valves disabled	2. 23.85 inches Hg
_____c. Standby vacuum pump starts	3. 21.35 inches Hg
_____d. EXHAUST PRESSURE HI alarm	4. 20.5 inches Hg
	5. 19 inches Hg
	6. 10 inches Hg

QUESTION: 067 (1.00)

With the plant operating at 100% power and pressurizer level control channel X selected, the output signal from Loop 1 Hot Leg control channel RTD (TE-111) fails LOW. Which of the following combinations indicates the resultant plant response with no operator actions?

	LETDOWN FLOW	B/U HEATERS	B/C CHARGING PUMP
a.	Increases	Deenergize	Starts
b.	Increases	Energize	Stops
c.	Decreases	Deenergize	Starts
d.	Decreases	Energize	Stops

QUESTION: 068 (1.00)

During accident recovery operations, the operators attempt to maintain the RCS subcooling margin (SCM) within minimum and maximum limits.

a. The minimum SCM required for HPSI pump stop and throttle operations is _____ degrees F. (0.5)

b. The maximum SCM allowed for pressurized thermal shock considerations is _____ degrees F. (0.5)

QUESTION: 069 (1.00)

Which of the following states the EOP-3 recovery actions required specifically for a LOCA outside containment (interfacing system LOCA) that has occurred while the plant was operating at full power?

a. Isolate letdown, RCS sampling, and shutdown cooling.

b. Initiate RAS in advance of STLS to conserve SIRWT inventory.

c. Drain all SI Tanks to RC Drain Tank to reduce tank pressures to less than 100 psig.

d. Use Atmospheric Dump Valve instead of Turbine Bypass Valves for plant cooldown.

QUESTION: 070 (1.00)

If two (2) power range safety channels become erratic while the reactor is at 80% power, and a reactor trip does NOT occur, which of the following is required? (Other power range safety channels are operating properly.)

a. Manually trip the reactor and enter EOP-00.

b. Within an hour place associated trip units (TUs) on one affected channel in bypass and associated TUs on the other channel in the tripped position; reduce power to 70% or less.

c. Within an hour reduce power to less than or equal to 15% and then trip the reactor and enter EOP-00.

d. Within an hour place associated trip units on both of the affected channels in bypass; reduce power to 70% or less.

QUESTION: 071 (1.00)

Following the clearance of tags on certain components, the operability of the component is required to be verified by operating the component. Per SO-O-1, "Conduct Of Operations", under which of the following conditions can this requirement be waived/omitted?

a. When the surveillance test on the component will be done within 7 days.

b. When testing the component would produce an unacceptable transient.

c. When a redundant component in the opposite train is already operable.

d. When the component is inside containment.

QUESTION: 072 (1.00)

Which ONE of the following is the correct power supply for the Emergency Response Facility Computer System [ERFCS] if the Normal 13.8 KV power supply and the ALTERNATE supply from the TSC Diesel Generator are BOTH lost?

a. DC Bus No. 2

b. DC Bus No. 3

c. Vital 125 VAC

d. TSC Battery

QUESTION: 073 (1.00)

On-the-spot changes may be implemented for which one of the following?

a. Emergency Operating Procedures.

b. Radiological Emergency Response Plan.

c. Operating Procedures.

d. Standing Orders.

QUESTION: 074 (1.00)

Personnel entry into a confined space is permitted if toxic gas in the confined space is less than 50 ppm Carbon Monoxide and the confined space atmosphere also meets which ONE of the following conditions?

a. Oxygen concentration is not less than 19.5%; explosive concentration is not greater than 10%.

b. Oxygen concentration is not less than 19.5%; explosive concentration is not greater than 4%.

c. Oxygen concentration is not less than 20%; explosive concentration is not greater than 4%.

d. Oxygen concentration is not less than 20%; explosive concentration is not greater than 10%.

Question deleted

QUESTION: 075 (1.00)

You are the Shift Supervisor when Systems Operations notifies you that electrical system switching must be performed. Which ONE of the following describes how a tag out of the affected components should be performed?

a. "Hold Order" tags and "Danger Do Not Operate" tags are both installed on affected components.

b. "Hold Order" tags and "Caution" tags are both installed on affected components.

c. "Danger Do Not Operate" tags and "Temporary Clearance" tags are both installed on affected components.

d. "Danger Do Not Operate" tags are the only tags installed on affected components.

QUESTION: 076 (1.00)

While walking through the Auxiliary Building, the Fire Watch Patrol discovers that a fire barrier is inoperable. The Fire Watch Patrol is required to report this discrepancy to which ONE of the following?

a. Security Supervisor

b. Security Roving Patrol

c. Shift Supervisor

d. Equipment Operator Nuclear Auxiliary

QUESTION: 077 (1.00)

If a woman operator declares that she is pregnant and she has already received 600 mrem since conception, which of the following exposure limits apply for the remainder of her pregnancy?

a. No further exposure [0 mrem].

b. 5 mrem

c. 25 mrem

d. 50 mrem

QUESTION: 078 (1.00)

Which of the following is correct concerning the use of gamma discrimination or gamma compensation in Wide Range Nuclear Instruments?

a. At low power levels gamma discrimination is not required since gamma radiation is insignificant compared to neutrons.

b. Compensated ion chambers are used with Wide Range Nuclear Instruments to compensate for gamma radiation.

c. In both the Campbelling circuits and log count rate circuits, compensation is achieved by taking the square root of the input signal.

d. Pulse height discrimination is used in the log count rate circuits; no discrimination is required when using the Campbelling circuits.

QUESTION: 079 (1.00)

Which ONE of the following provides seal water cooling for the Containment Spray Pumps?

a. CCW only.

b. Raw water only.

c. CCW with backup from Raw water.

d. Raw water with backup from the Fire Main.

QUESTION: 080 (1.00)

Which ONE of the following is the source of electrical power for the Primary CEA Position Indication System Synchros?

a. 120 VAC Instrument Buses AI-40A or B and AI-40C or D, through manual bus selector switches and 48 VDC power supplies.

b. 125 VDC bus #2, through 120 volt, 400 hertz inverter.

c. 120 VAC instrument Bus AI-42A, through a 5 VDC power supply.

d. 480 VAC MCC 3B1 or 4A1, through 480V/120V transformers and a manual selector switch.

QUESTION: 081 (1.00)

Pressurizer Pressure Transmitter PT-[illegible] provides an input to which ONE of the following?

a. Engineered Safeguards to generate the Pressurizer Pressure Low Signal [PPLS].

b. Auxiliary Feed Actuation System [AFAS] cabinets for use by the Diverse Scram System.

c. Reactor Protective System [RPS] for input to the high pressurizer pressure trip.

d. Reactor Protective System [RPS] for input to the TM/LP trip.

QUESTION: 082 (1.00)

During power operations, if containment entry is required then the Shift Supervisor and which ONE of the following must approve?

a. Radiation Protection Supervisor OR Operations Supervisor

b. Radiation Protection Supervisor AND Operations Supervisor

c. Plant Manager OR Chemistry and Radiation Protection Supervisor

d. Plant Manager AND Chemistry and Radiation Protection Supervisor

Question deleted.

QUESTION: 083 (1.00)

Service air is used on the Refueling Machine to operate which of the following components?

a. The spreader, the hoist, the Dillon Load Cylinder, and the mast rotator.

b. The spreader, the mast rotator, and the camera tilt mechanism.

c. The spreader, the grapple activator, and the mast detent.

d. The mast bumper air cylinder, the mast rotator, and the grapple activator.

QUESTION: 084 (1.00)

Which one of the following describes the response of the Chemical and Volume Control System (CVCS) to a Safety Injection Actuation Signal (SIAS)?

a. Both BA pumps start; VCT outlet valve (LCV-218-2) closes; and letdown pressure control valve (PCV-210) closes.

b. VCT outlet valve (LCV-218-2) closes; letdown isolation valve (HCV-204) closes; and letdown flow control valves (LCV-101-1/2) close.

c. BA pump recirc valves (HCV-257 and HCV-264) close; VCT makeup stop valve (HCV-269) closes; and letdown flow control valves (LCV-101-1/2) close.

d. Both BA pumps start; VCT makeup stop valve (HCV-269) closes; and BA pump recirc valves (HCV-257 and HCV-264) close.

QUESTION: 085 (1.00)

Which signals will provide a direct automatic trip to a running Steam Generator Feed Pump during full power operations?

a. Phase differential relay trip and loss of all heater drain pumps

b. Loss of all condensate pumps and phase differential relay trip

c. Lube oil pressure at 6 psig and loss of two condensate pumps

d. Overcurrent at 200 percent of rated full load and lube oil pressure at 6 psig

QUESTION: 086 (1.00)

During a plant cooldown from the Alternate Shutdown Panel, Section III of AOP-6 (Fire Emergency) requires the TSC and I&C Department to coc ⌇inate monitoring a parameter via its containment penetration.

Which of the following is the parameter that is monitored using this method?

a. Containment temperature

b. RCS wide range temperature

c. RCS wide range pressure

d. Reactor vessel head temperature

QUESTION: 087 (1.00)

The reactor has just tripped from 100% power. Which one of the following states the approximate time after the trip at which the NIS WR extended range circuit will automatically energize?

a. 6 minutes

b. 12 minutes

c. 24 minutes

d. 48 minutes

QUESTION: 088 (2.00)

MATCH the operator actions in Column A to the shift position in Column B designated in AOP-6 (Fire Emergency) to perform the action for a control room evacuation. (0.5 each)

(Numbers in column B may be used once, more than once, or not at all, but only a single answer may occupy each answer space.)

Column A (OPERATOR ACTION)		Column B (SHIFT POSITION)
___	a. Establish boration flowpath	1. SS 2. LSO
___	b. Open roll-up doors in east switchgear room.	3. STA 4. EONA 5. EONT
___	c. Establish control at AI-179.	6. AON 7. Communicator
___	d. Isolate EDG 2 from Control Room	8. Licensed Operator

QUESTION: 089 (1.00)

Conditions have occurred such that the 13.8KV/480V transformer must supply 480V Bus 1B3C. The maximum total amperage allowed for the loads on Bus 1B3C is:

a. 300 amps

b. 600 amps

c. 1000 amps

d. 1500 amps

QUESTION: 090 (1.00)

Which of the following conditions would prevent electrical operation of disconnect switch DS-T1?

a. Generator output breaker 3451-4 being OPEN

b. Isophase bus duct cooling fan A being OFF

c. Generator field breaker 41E/G1F being CLOSED

d. One turbine control valve being OPEN

QUESTION: 091 (1.00)

AOP-01, "Acts of Nature," is implemented when:

a. A tornado is sighted in the MAPP system area.

b. A tornado warning is issued for the plant area.

c. A high winds alert is issued for the MAPP system area.

d. Sustained wind speeds exceed 40 mph in the plant area.

QUESTION: 092 (1.00)

Which of the following lists the automatic actuations that occur in the Instrument Air System on decreasing air pressure?

a. PCV-1752 (Dryer Bypass Valve) opens at 78 psig and PCV-1753 (Service Air System Shutoff Valve) opens at 80 psig.

b. PCV-1752 opens at 78 psig and PCV-1753 closes at 80 psig.

c. PCV-1752 closes at 80 psig and PCV-1753 opens at 78 psig.

d. PCV-1752 closes at 80 psig and PCV-1753 closes at 78 psig.

QUESTION: 093 (1.00)

Which of the following is the basis for the Technical Specification requirement to reduce T-avg below 536 degrees F within 6 hours when RCS activity exceeds 60 uc/gm DOSE EQUIVALENT I-131?

a. Prevents the dissolution of fission products into the reactor coolant.

b. Increases reliability of the data collected for determination of actual iodine activity level.

c. Prevents release of radioactivity if a steam generator tube should concurrently rupture.

d. Increases coolant density and resultant self shielding thereby reducing on-site exposure.

QUESTION: 094 (2.00)

Match the type of long-term RCS leakage in column A with the associated Technical Specifications (TS) limit in column B. [0.5 each]

(The numbers in column B may be used once, more than once, or not at all and only one number may occupy each answer space.)

COLUMN A (RCS LEAKAGE)	COLUMN B (TECH SPEC LIMIT)
_____a. Possible pressurizer heater weld leak	1. 0.3 gpm
_____b. Confirmed pressurizer safety valve seat leakage	2. 1 gpm
	3. 2 gpm
_____c. Total S/G tube leakage	4. 5 gpm
_____d. RCP seal controlled bleedoff	5. 10 gpm
	6. No TS limit

QUESTION: 095 (1.00)

During a design basis LOCA, how will the onset of voiding in the downcomer region of the reactor vessel affect the indication of the excore (wide-range) nuclear instrumentation?

a. Indicated flux level will decrease because the decreased coolant density will cause less fast neutron thermalization.

b. Indicated flux level will increase because the decreased coolant density will allow more neutron leakage.

c. Indicated flux level will decrease because the void will displace boron from the downcomer into the core causing a negative reactivity effect.

d. Indicated flux level will increase because the decreased coolant density will cause a positive reactivity effect in a partially voided core.

QUESTION: 096 (1.00)

Which of the following explains the cause of the sharp increase in reactor coolant iodine radioactivity noted while increasing plant power?

a. Iodine is normally contained within the fuel pins but escapes via pinhole leaks during a power increase.

b. Iodine is released from the burnable poison pins because the rate of neutron absorption increases during a power increase.

c. Iodine is a daughter product of xenon which increases during a power increase.

d. Iodine is released from the CVCS demineralizers due to the influx of crud during a power increase.

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

ANSWER: 001 (1.00)

b.

REFERENCE:

10 CFR 20, para. 20.101
Both
[2.8/3.4]

194001K103 ..(KA's)

ANSWER: 002 (1.00)

b.

REFERENCE:

Fort Calhoun Station S.O. G-52-2
Both
[2.5/3.4]

194001A103 ..(KA's)

ANSWER: 003 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: Lesson Plan 7-53-2, p.7
SRO Only
[3.1/3.4]

194001A115 ..(KA's)

ANSWER: 004 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-G-28, p.7 of 141
Both
[3.5/4.2]

194001K116 ..(KA's)

ANSWER: 005 (1.00)

d.

REFERENCE:

10CFR55.13.a.2: SO-O-1, p. 38

194001A111 ..(KA's)

ANSWER: 006 (1.00)

c.

REFERENCE:

10CFR55.53e

194001A103 ..(KA's)

ANSWER: 007 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-O-22, p.1 of 3
Radiation Protection Procedure RP-213, p.2 of 6
Both
[3.1/3.4]

194001K105 ..(KA's)

ANSWER: 008 (1.00)

d.

REFERENCE:

Fort Calhoun Station SO-O-1, p.85 of 97
Both
[2.7/3.9]

194001K109 ..(KA's)

ANSWER: 009 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-O-1, p.58, 59, 60, 61
Both
[2.5/3.4]

194001A103 ..(KA's)

ANSWER: 010 (1.00)

d.

REFERENCE:

Fort Calhoun Station SO-01, p.81
Both
[3.4/3.4]

194001A106 ..(KA's)

ANSWER: 011 (1.00)

b.

REFERENCE:

Fort Calhoun Station SO-O-20, p.5
Both
[3.6/3.7]

194001K101 ..(KA's)

ANSWER: 012 (1.00)

d.

REFERENCE:

Technical Specifications p. 6 [Definitions]
Both
[2.8/3.4]

001000K553 ..(KA's)

ANSWER: 013 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-12-26, p.36
Question Bank 1-7-26,1.8 003
Both
[2.8/3.3]

001000K602 ..(KA's)

ANSWER: 014 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-11-20, p.32
Both
[3.6/3.6]

003000A304 ..(KA's)

ANSWER: 015 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-11-20, p.89 & 90
Both
[2.7/3.1]

003000K602 ..(KA's)

ANSWER: 016 (1.00)

c.

REFERENCE:

Systems Training Manual CVCS, p.11
Both
[3.4/3.1]

004020A303 ..(KA's)

ANSWER: 017 (1.00)

d.

REFERENCE:

Systems Training Manual CVCS, p.25
Both
[3.4/3.7]

004000K123 ..(KA's)

ANSWER: 018 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-12-14, p. 37
Both
[3.6/3.8]

013000K108 ..(KA's)

ANSWER: 019 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-12-19, p.33
Both
[3.1/3.2]

015000K604 ..(KA's)

ANSWER: 020 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-12-20, p.8
Both
[3.1/3.3]

017020K403 ..(KA's)

ANSWER: 021 (1.00)

c.

REFERENCE:

System Training Manual - Containment, p.23, 29
Both
[3.3/3.5]

022000G007 ..(KA's)

ANSWER: 022 (1.00)

a.

REFERENCE:

Systems Training Manual --- CF, p.43, 44
Both
[2.6/2.6]

056000K103 ..(KA's)

ANSWER: 023 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-11-11. p.15
Exam Bank 1-7-11-11,1.2 001
Both
[3.1/3.1]

059000G009 ..(KA's)

ANSWER: 024 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-11-1. p.54
Both
[2.5/2.8]

061000K601 ..(KA's)

ANSWER: 025 (1.00)

a.

REFERENCE:

Procedure OI-WDL-3, p.7 of 35
Both
[3.6/3.6]

068000A302 ..(KA's)

ANSWER: 026 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-12-3, p.55
Both
[2.5/2.8]

071000G007 ..(KA's)

ANSWER: 027 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-12-3, p.27
Both
[3.6/4.2]

073000K301 ..(KA's)

ANSWER: 028 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: p.12, 13
Both
[2.7/3.0]

072000K501 ..(KA's)

ANSWER: 029 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-11-20, p.110, 111
Both
[2.9/3.2]

002000K403 ..(KA's)

ANSWER: 030 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-13-2, p.7
Fort Calhoun Station IHB: 7-11-22, p.25
Both
[3.6/3.9]

006000K201 ..(KA's)

ANSWER: 031 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-11-22, p.26, 27
Both
[3.6/3.9]

006000K603 ..(KA's)

ANSWER: 032 (1.00)

c.

REFERENCE:

Systems Training Manual --- RCS, p.37
Both
[3.4/3.6]

011000A211 . (KA's)

ANSWER: 033 (1.00)

a.

REFERENCE:

Systems Training Manual --- RCS, p.48
Both
[4.0/3.8]

010000A403 ..(KA's)

ANSWER: 034 (1.00)

c.

REFERENCE:

Systems Training Manual ---RP, p.26,27
Both
[4.5/4.5]

012000K401 ..(KA's)

ANSWER: 035 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-14-3, p.11
Both
[3.6/3.8]

029000K103 ..(KA's)

ANSWER: 036 (1.00)

d.

REFERENCE:

Systems Training Manual --- SFC, p.7
Both
[2.5/2.6]

033000G009 ..(KA's)

ANSWER: 037 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-13-5, p. 44, 53
RO only
[3.9/4.2]

064000K402 ..(KA's)

ANSWER: 038 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-13-5, p.9, 10
STM --EDG, p.33
Both
[3.4/3.6]

064000G010 ..(KA's)

ANSWER: 039 (1.00)

d.

REFERENCE:

Systems Training Manual ---ED, p.15 and 38
Both
[3.7/4.2]

062000K104 ..(KA's)

ANSWER: 040 (1.00)

c.

REFERENCE:

Systems Training Manual --- MS, p.22
Both
[3.2/3.6]

035010K601 ..(KA's)

ANSWER: 041 (1.00)

b.

REFERENCE:

Systems Training Manual --- FP, p.5
Both
[3.0/3.4]

086000K402 ..(KA's)

ANSWER: 042 (1.00)

b.

REFERENCE:

System Training Manual, ECC, p.22
Both
[3.2/3.5]

005000K407 ..(KA's)

ANSWER: 043 (1.00)

d.

REFERENCE:

Systems Training Manual, RCS, p.53
Procedure OI-RC-6
Both
[2.9/3.1]

007000A101 ..(KA's)

ANSWER: 044 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-11-6, p.26, 27
Both
[3.3/3.1]

008000A401 ..(KA's)

ANSWER: 045 (1.00)

a.

REFERENCE:

Fort Calhoun Station IHB: 7-11-19, p.9
Both
[2.7/3.1]

076000A202 ..(KA's)

ANSWER: 046 (1.00)

d.

REFERENCE:

FCS AOP-3, LP 7-12-26, TDB FIG II.b.6, OP-10 pg A8-13
(4.1, 4.4)

000024K301 ..(KA's)

ANSWER: 047 (1.00)

b.

REFERENCE:

FCS STM Rad Mon pg 14
(3.1/3.3)

000076A104 ..(KA's)

ANSWER: 048 (1.00)

c.

REFERENCE:

Steam Tables
(3.6, 4.1)

000008K302 ..(KA's)

ANSWER: 049 (2.00)

a. 4
b. 4
c. 2
d. 2

REFERENCE:

FCS LP 7-11-7; AOP-17 ATTACHMENT 1
(2.9, 3.3)

000065A208 ..(KA's)

ANSWER: 050 (1.00)

c.

REFERENCE:

FCS QB 1-7-17-08,1.1,N 001
(3.4, 4.1)

000036A202 ..(KA's)

ANSWER: 051 (2.00)

a. 5
b. 2
c. 4
d. 3

REFERENCE:

FCS 7-11-20 pg 89
(4.0/4.2)

000015A122 ..(KA's)

ANSWER: 052 (1.00)

d.

REFERENCE:

FCS TDB FIG. III.1.c
(3.4, 3.6)

000009K310 ..(KA's)

ANSWER: 053 (1.00)

b.

REFERENCE:

LP 7-13-1 pg 17; EO 1.4; EOP Att 5
(3.9/4.0)

000055G012 ..(KA's)

ANSWER: 054 (1.00)

a.

REFERENCE:

LP 7-15-12; EO 1.4
(3.4/3.8)

000007K102 ..(KA's)

ANSWER: 055 (1.00)

c.

REFERENCE:

LP 7-15-23; EO 1.2
(4.1/4.4)

000011K101 ..(KA's)

ANSWER: 056 (1.00)

c.

REFERENCE:

LP 7-15-28; EO 1.8
(3.9/4.0)

000009K306 ..(KA's)

ANSWER: 057 (1.00)

c.

REFERENCE:

EOP-00, EOP Attach 2
(3.4/3.4)

000015G010 ..(KA's)

ANSWER: 058 (1.00)

b.

REFERENCE:

LP 7-18-10, pg. 27
(4.0/4.6)

000007K301 ..(KA's)

ANSWER: 059 (1.00)

d.

REFERENCE:

AOP-2, Sect IV
(4.4/4.6)

000001A205 ..(KA's)

ANSWER: 060 (1.00)

d.

REFERENCE:

LP-7-18-10
(3.9/4.0)

000055G012 ..(KA's)

ANSWER: 061 (1.00)

c.

REFERENCE:

7-11-5, p. 30
7-12-3, EO 4.1, p. 30
(3.9/4.1)

000038K304 ..(KA's)

ANSWER: 062 (1.00)

c.

REFERENCE:

EOP Attachment 14
(4.0/4.6)

000074A206 ..(KA's)

ANSWER: 063 (1.00)

d.

REFERENCE:

EOP-00
(3.8/4.1)

000054K303 ..(KA's)

ANSWER: 064 (1.00)

d.

REFERENCE:

EOP-00; Steam Tables
(4.6/4.9)

000074A201 ..(KA's)

ANSWER: 065 (1.00)

b.

REFERENCE:

TDB
(3.3/4.1)

000005K105 ..(KA's)

ANSWER: 066 (2.00)

a. 3
b. 5
c. 1
d. 2 (0.5 each)

REFERENCE:

AOP-26, p. 4
(3.9/4.1)

000051A202 ..(KA's)

ANSWER: 067 (1.00)

b.

REFERENCE:

STM RIRR, pg. 25
(3.3/3.4)

000028A210 ..(KA's)

ANSWER: 068 (1.00)

a. 20
b. 200 (0.5 each)

REFERENCE:

LP 7-15-23, pg. 39
(3.9/4.1)

000011A114 ..(KA's)

ANSWER: 069 (1.00)

a.

REFERENCE:

LP 7-15-23, pg.42; LO 2.9
(3.4/3.7)

000009K312 ..(KA's)

ANSWER: 070 (1.00)

b.

REFERENCE:

ECS Exam Bank Question I-7-17-15, 1.4, N 001
(2.8/3.4)

000033G008 ..(KA's)

ANSWER: 071 (1.00)

b.

REFERENCE:

Fort Calhoun Station SO-O-1, p. 43 of 97
SRO Only
[2.9/3.9]

194001A110 ..(KA's)

ANSWER: 072 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: Lesson Plan 7-53-2, p.8 & 9.
Both
[3.1/3.4]

194001A115 ..(KA's)

ANSWER: 073 (1.00)

c.

REFERENCE:

Fort Calhoun Station SO-G-30, p.19 of 31
SRO only
[4.1/3.9]

194001A102 ..(KA's)

ANSWER: 074 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO G-45, p.1 of 5
SRO Only
[3.3/3.6]

194001K113 ..(KA's)

ANSWER: 075 (1.00)

a.

REFERENCE:

Fort Calhoun Station SO-O-20, p.23
SRO only
[3.7/4.1]

194001K102 ..(KA's)

ANSWER: 076 (1.00)

c.

REFERENCE:

Fort Calhoun Station SO-O-38, p.1
SRO only
[3.1/4.1]

194001A112 ..(KA's)

ANSWER: 077 (1.00)

~~d.~~ a.

REFERENCE:

FCS "Radiation Protection Administrative Procedure", RP-AD-600,
Section 5.6.2, p.7
SRO only
[3.3/3.5]

194001K104 ..(KA's)

ANSWER: 078 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-12-18, p. 15, 16, 35
Exam Bank 1-7-12-18,1.3,N 001
SRO only

015000K602 ..(KA's)

ANSWER: 079 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: 7-11-22, p.24
System Training Manual ECC, p.14
SRO only
[3.6/3.9]

026000G004 ..(KA's)

ANSWER: 080 (1.00)

b.

REFERENCE:

Fort Calhoun Station IHB: 7-12-26, p.31,32
SRO only
[2.8/3.0]

014000G007 ..(KA's)

ANSWER: 081 (1.00)

b.

REFERENCE:

Systems Training Manual --- RP, 19, 29
SRO only
[2.7/2.8]

012000K606 ..(KA's)

ANSWER: 082 (1.00)

d.

REFERENCE:

Fort Calhoun Station IHB: 7-11-8, p.34
SRO only
[3.3/3.9]

103000G001 ..(KA's)

ANSWER: 083 (1.00)

c.

REFERENCE:

Fort Calhoun Station IHB: p. 9
Exam Bank 1-7-13,1.5,N 001
SRO only
[2.5/2.8]

034000G004 ..(KA's)

ANSWER: 084 (1.00)

d.

REFERENCE:

System Training Manual, "Chemical and Volume Control System",
page 44.
(4.4/4.4)

000009A113 ..(KA's)

ANSWER: 085 (1.00)

d.

REFERENCE:

Lesson Plan 7-11-11, "Feedwater and Feedwater Regulating System", EO 2.3, page 14.
(4.1/4.4)

000054A202 ..(KA's)

ANSWER: 086 (1.00)

b.

REFERENCE:

1. AOP-6, "Fire Emergency", page 28 of 113.
2. 000068A121 (3.9/4.1), 000068K318 (4.2/4.5).

000068K318 000068A121 ..(KA's)

ANSWER: 087 (1.00)

c.

REFERENCE:

FCS NIS STM, p. 10
(2.6/2.9)

000032A201 ..(KA's)

ANSWER: 088 (2.00)

a. 4
b. 8
c. 2
d. 5

REFERENCE:

FCS AOP-06
(4.1, 4.2)

000068G010 ..(KA's)

ANSWER: 089 (1.00)

a.

REFERENCE:

LP 7-13-1 pg 17; EO 1.4b
(3.6/3.7)

000055G007 ..(KA's)

ANSWER: 090 (1.00)

c.

REFERENCE:

LP 7-13-1 pg 28; EO 1.5c
(4.4/4.7)

000056K302 ..(KA's)

ANSWER: 091 (1.00)

b.

REFERENCE:

LP 7-17-1; EO 1.2
(4.0/4.2)

000069G011 ..(KA's)

ANSWER: 092 (1.00)

b.

REFERENCE:

AOP-17
(3.0/3.2)

000065K304 ..(KA's)

ANSWER: 093 (1.00)

c.

REFERENCE:

Technical Specification Section 2.1.3, page 2-9
(3.2/3.8)

000076K306 ..(KA's)

ANSWER: 094 (2.00)

a. 2
b. 5
c. 2
d. 6 (0.5 each)

REFERENCE:

Tech Specs 2.1.4
(4.0/4.2)

000015A122 ..(KA's)

ANSWER: 095 (1.00)

b.

REFERENCE:

LP 7-15-28, pg. 84
LO 1.16a
(4.6/4.8)

000074K102 ..(KA's)

ANSWER: 096 (1.00)

a.

REFERENCE:

LP RO-301-15
Tech Spec 2.1.3
(2.9/3.6)

000076K305 ..(KA's)

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

A N S W E R K E Y

MULTIPLE CHOICE

001	b
002	b
003	a
004	a
005	d
006	c
007	a
008	d
009	a — deleted per facility comment
010	d
011	b
012	d
013	c
014	a
015	b
016	c
017	d
018	a
019	b
020	b
021	c
022	a
023	d
024	c
025	a
026	d
027	c
028	b
029	d
030	b
031	b
032	c
033	a
034	c
035	b
036	d
037	a
038	a
039	d
040	c
041	b
042	b
043	d
044	b
045	a

A N S W E R K E Y

046 d

047 b

048 c

049 MATCHING

a 4

b 4

c 2

d 2

MULTIPLE CHOICE

050 c

051 MATCHING

a 5

b 2

c 4

d 3

MULTIPLE CHOICE

052 d

053 b

054 a

055 c

056 c

057 c

058 b

059 d

060 d

061 c

062 c

063 d

064 d

065 b

066 MATCHING

a 3

b 5

c 1

d 2

MULTIPLE CHOICE

067 b

068 ~~MATCHING~~

a 20

b 200

MULTIPLE CHOICE

069 a

070 b

071 b

072 d

073 c

A N S W E R K E Y

074 a deleted

075 a

076 c

077 d

078 d

079 c

080 b

081 b

082 d deleted per facility comment

083 c

084 d

085 d

086 b

087 c

088 MATCHING

a 4

b 6

c 2

d 5

MULTIPLE CHOICE

089 a

090 c

091 b

092 b

093 c

094 MATCHING

a 2

b 5

c 2

d 6

MULTIPLE CHOICE

095 b

096 a

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

5.0 REQUIREMENTS

5.1 Plant Staff within the scope of application shall be limited to the following maximum working hours:

5.1.1 An individual shall not be permitted to work more than 16 hours straight (excluding shift turnover time).

5.1.2 An individual shall not be permitted to work more than 16 hours in any 24-hour period, nor more than 24 hours in any 48-hour period, nor more than 72 hours in any seven day period (all excluding shift turnover time).

5.1.3 A break of at least eight hours shall be allowed between work periods (including shift turnover time). A work period is defined as eight (8) or more hours.

5.1.4 Except during extended shutdown periods, the use of overtime shall be considered on an individual basis and not for the entire staff on shift.

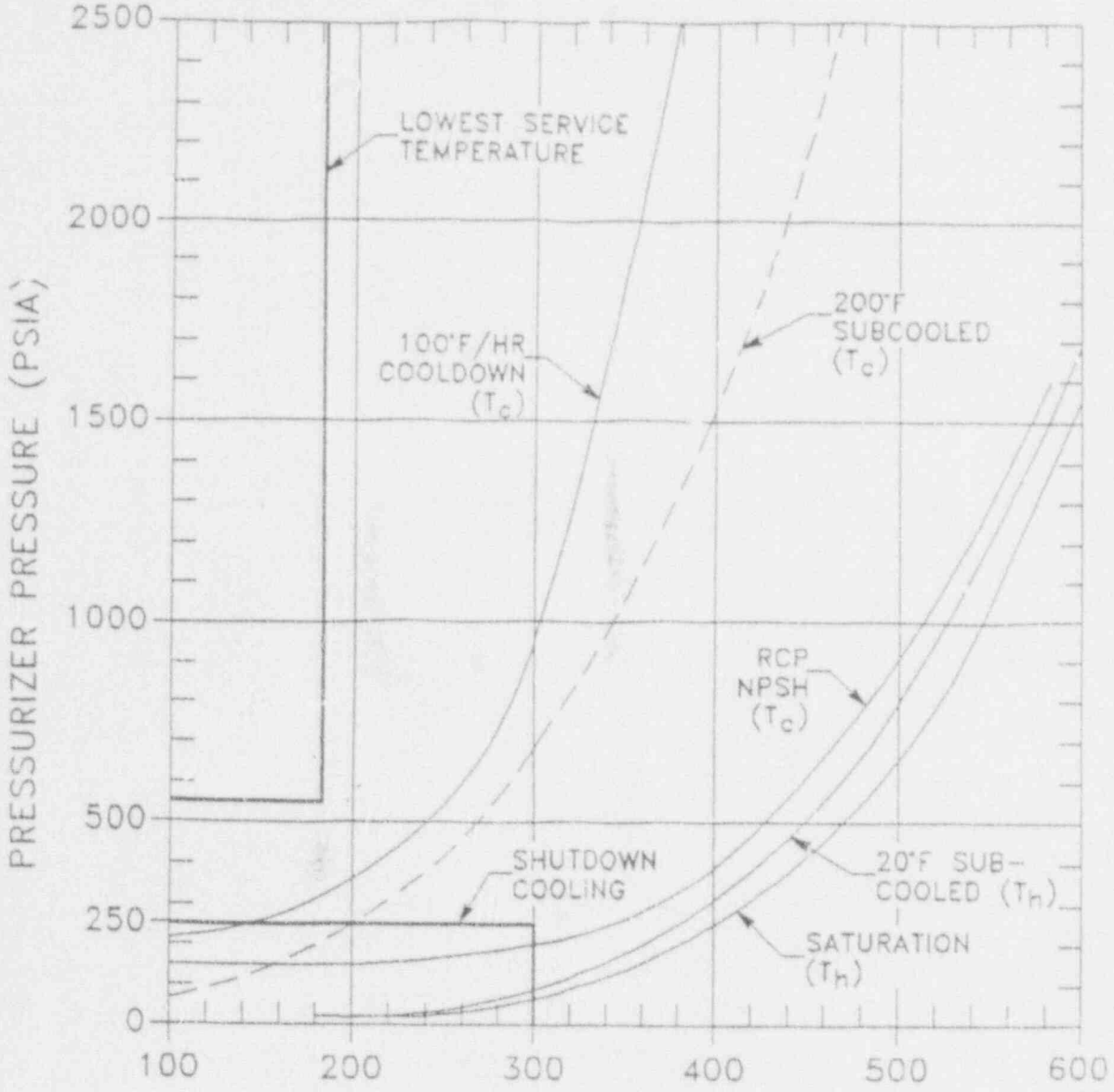
5.2 Section 5.1 points out the guidelines to be followed and in the event that special circumstances arise or emergency conditions exist, deviation from these guidelines may become necessary.

5.2.1 If such deviations are necessary only the Manager - Fort Calhoun Station or his designated alternate may approve them.

5.2.2 All such deviations shall be documented on a Form FC-70.

ATTACHMENT 2

RCS PRESSURE-TEMPERATURE LIMITS



NOTES

1. This curve is only valid through 14 EFPY.

2. 200°F subcooled curve supersedes 100°/HR cooldown curve anytime RCS has experienced an uncontrolled cooldown causing RCS temperature to go below 500°F.

3. To be the most conservative during forced circulation, T_h, or during natural circulation, CETs should be used for the 20°F subcooled and the saturation curve. T_c should be used for all other curves.

ATTA(.MENT 2

RCS PRESSURE-TEMPERATURE LIMITS

RCS TEMPERATURE (°F)	MINIMUM PRESSURE TO MEET RCP NPSH (psia)
82	155
140	155
203	155
240	168
260	178
280	194
300	212
320	239
340	265
359	300
380	351
400	412
425	500
450	600
480	750
500	900
520	1050
540	1200
562	1400
582	1600

Fort Calhoun Station
Unit No. 1

TDB-V.9

TECHNICAL DATA PROCEDURE

Title: SHUTDOWN MARGIN WORKSHEET

Setpoint/Procedure Form Number (FC-68):	38238
Reason for Change:	Correct figure references and make procedure easier to read.
Contact Person:	Keith Voss

SHUTDOWN MARGIN WORKSHEET

PART I - Instantaneous Shutdown Margin for use prior to a Reactor Trip or immediately following a reactor trip. No changes are assumed for xenon, since this worksheet is only applicable for calculation of an instantaneous shutdown margin.

NOTE: Enter values exactly as determined from the figures in the Technical Data Book and carry the algebraic signs through the calculations.

Condition

1. Present Date/Time: _____/_____

2. Reactor Power: (before trip) _____%

3. CEA Positions:

Group 1_____ inches

Group 2_____ inches

Group 3_____ inches

Group 4_____ inches

4. Reactor Coolant System Boron Concentration prior to shutdown: (Boron concentration analysis must have been performed within the past 24 hours or more recently if boration or dilution has occurred.)

_____ppm

5. Burnup (Take the most recent burnup from the Control Room Log and add approximately 32 mwd/mtu per EFPD. Determine BOC or EOC.

_____MWD/MTU

Calculation of Shutdown Margin

6. Enter Regulating Group Worths, based on burnup, see 5, above. (Enter TDB Figure II.B.2.A, B or C and using the CEA positions from 3. above.)

_____ Δρ
6.

7. Shutdown Group Worths, based on burnup, see 5. above. (Enter TDB Section II.B.1.a., select correct column.)

   a. Shutdown Group B _____ % Δρ

   b. Shutdown Group A _____ % Δρ

   c. Total Shutdown Worth (add a. and b. above) _____ % Δρ
   7.c.

8. Determine Power Defect

   Use TDB Figure II.C.2.a, b, or c, reactor power (before trip), and burnup 2. and 5. above, to calculate power defect.

   _____ % Δρ
   8.

9. Determination of Stuck Rod Allowance (3 cases)

   a. Case I - All rods are assumed to be operable. (No known inoperable rods.)

      Assume the highest worth rod will stick out of the core upon a reactor trip. Enter the value of the most reactive rod, based on burnup, (see 5. above) from TDB Figure II.B.1.b., lines (1) thru (3) for the pre-trip configuration. Select the correct column.

      _____ % Δρ
      9.A.

      (Enter N/A if this case is not applicable.)

   b. Case II - One CEA is known to be inoperable (per Tech. Spec. 2.10.2(4) a.)

      Account for this defective CEA (and the highest worth stuck rod) by entering only the value from lines (4) thru (36) of TDB Figure II.B.1.b. for the inoperable rod, based on burnup, (see 5. above). Select the correct column.

      _____ % Δρ
      9.B.

      (Enter N/A if this case is not applicable.)

      NOTE: The values of lines (4) thru (36) of TDB Figure II.B.1.b. Include the total reactivity associated with the known inoperable rod and the highest worth rod which is assumed to stick out of the core upon a reactor trip.

c. Case III - More than one CEA is known to be inoperable (per Tech. Spec. 2.10.1.(4) a.).

(Enter n/A if this case is not applicable.)

(1) Enter total number of CEA's which are known to be inoperable per Tech. Spec. 2.10.2.(4) a.

_____ (1)

(2) Enter the worst stuck rod worth from TDB Figure II.B.1.b. lines (1) thru (3) for the pre-trip configuration, based on burnup, (see 5. above). Select the correct column.

_____ (2) % Δρ

(3) Enter the most conservative defective CEA worth from TDB Figure II.B.1.b. Lines (4) thru (36) depending on defective rod(s) location, based on burnup, (see 5. above). Select the correct column.

_____ (3) % Δρ

[[(# _____ (1)) - 1] x (_____ (2) % Δρ)] + (_____ (3) % Δρ) = _____ 9.c. % Δρ

d. Enter value from 9.A. or 9.B. or 9.C. as appropriate _____ 9.D. % Δρ

10. Calculation of the Total Instantaneous Shutdown Margin: (carry signs)

_____ 9.D. % Δρ + _____ 8. % Δρ - _____ 7.c. % Δρ

-(_____ 6. % Δρ) = _____ 10. TOTAL % Δρ

(CEA's which do not insert) + (power defect) - (total shutdown CEA worth) - (total regulating group worth) = Total instantaneous shutdown margin

11. Calculate difference from required -4.0% Δρ Shutdown Margin.

(_____ 10. % Δρ) + 4.0% Δρ = _____ 11. % Δρ

12. a. If 11. is less than or equal to zero, the shutdown margin is adequate.

b. If 11. is greater than zero, use OI-ERFCS-1, Procedure 36 to determine the number of gallons of acid to add.

NOTE: A -4.0% Δρ shutdown margin must be maintained in a hot shutdown condition, Tc > 210°F (Tech. Spec. 2.10.2 (i)).

PART II - Hot Shutdown Condition (No Rod Movement Planned)

Assumptions: No Xenon, Equilibrium Samarium, All Rods In, T_{AVG} >515F

Conditions

		INITIALS/DATE
1. Date/Time:	____/____	____/____
2. Burnup:	_____MWD/MTU	____/____
3. Verify that the Reactor Coolant System Average Temperature is greater than 515 F.		
Record RCS Average Temp	=_____°F	____/____
4. Reactor Coolant System Boron Concentration (Boron Analysis must have been performed within the past 24 hours or more recently if boration or dilution has occurred).	_____ppm	____/____
5. Verify that all Regulating and Shutdown CEA's are inserted to at least the Lower Electrical Limits (LEL).		____/____

Soluble Boron Concentration

6. Calculate the necessary Soluble Boron Concentration change:

   Using core burnup (2.) and TDB Figure II.A.3.b. based upon Group N position, determine the necessary soluble boron concentration.

   _____ppm

7. Compare the Actual Boron Concentration to the Soluble Boron Concentration.

   _____ppm (4.) - _____ppm (6.) = _____ ppm

8. a. If 7. is greater than or equal to zero, the boron concentration is adequate.

   b. If 7. is less than zero, use OI-ERFCS-1, Procedure 36 or manual calculations and borate to the reactor coolant system concentration given in 6.

REMARKS_____

_____

_____

Completed by_____Date/Time____/____

PART III - T_{ave} Less Than 515°F

Conditions — INITIALS/DATE

1. Date/Time: _____ _____/_____

2. Burnup: _____ MWD/MTU _____/_____

3. Verify that the Reactor Coolant System Average Temperature (TR-346) or indicated loop temperature is less than 515 F using a. or b. below.

   a. If on shutdown cooling, use

   1/2 * [(_____ + _____)]
   Outlet Suction

   = _____ °F

   b. If not on shutdown cooling, then use RCS loop temperature indication for T_{ave}.

   = _____ °F _____/_____

4. Reactor Coolant System Boron Concentration (Boron Analysis must have been performed within the past 24 hours or more recently if boration or dilution has occurred.) _____ ppm _____/_____

Soluble Boron Concentration

5. Calculate the necessary Soluble Boron Concentration: Use the applicable TDB Figure II.A.3, based on RCS temperature, 3.a or 3.b, and core burnup, 2, If in Mode 5 enter the refueling Boron Concentration. _____ ppm

6. Compare the actual boron concentration to the soluble boron concentration.

   _____ ppm - _____ ppm = _____ ppm
   4 5

7. a. IF 6 is greater than or equal to zero, the boron concentration is adequate.

   b. IF 6 is less than zero, use OI-ERFCS-1, Procedure 36 or manual calculations and borate to the reactor coolant system concentration given in 5.

REMARKS _____

_____

Completed by _____ Date/Time _____/_____

PART IV - Use to calculate Shutdown Margin when the Reactor is in a hot or cold shutdown with possible rod movement or inoperable CEA's, or not at equilibrium xenon.

NOTE: Enter values exactly as determined from the figures in the Technical Data Book and carry the algebraic signs through the calculations.

Condition

1. Present Date/Time _____/____

2. Date/Time of Shutdown _____/____

3. Hours elapsed since shutdown _____Hours

4. Reactor power level before shutdown (% of 1500 MWth) _____%

5. Reactor Coolant cold leg temperature: _____ ___ _____°F
Tc

6. Circle appropriate shutdown condition

Tc $\geq$ 210°F---> Hot shutdown margin required

Tc < 210°F---> Cold shutdown margin required

7. CEA Positions before shutdown

Regulating Groun 1 _____inches

Regulating Group 2 _____inches

Regulating Group 3 _____inches

Regulating Group 4 _____inches

8. Burnup: (.ake the most recent burnup from the Control Room Log and add approximately 32 mwd/mtu per EFPD.) Determine BOC or EOC.

_____MWD/MTU

9. Worth of change in boron concentration

a. Reactor coolant system boron concentration prior to shutdown or trip.

_____ppm
9.a.

b. Inverse boron worth for power level prior to shutdown (using TDB Figure II.A.4. with burnup, 8.)

_____ppm/% $\Delta\rho$
9.b.

c. Reactive worth for initial boron concentration.

_____ / _____ = _____% Δρ
9.a. 9.b. 9.c.

d. Present reactor coolant boron concentration

_____ppm
9.d.

e. Inverse boron worth for hot zero power (HZP) using TDB Figure II.A.4. with burnup, 8.

_____ppm/% Δρ

f. Reactive worth for present boron concentration.

_____ / _____ = _____% Δρ
9.d. 9.e. 9.f.

g. Change in reactive worth for change in boron concentration.

_____ - _____ = _____% Δρ
9.f. 9.c. 9.g.

Calculation of Shutdown Margin

10. Determine Power Defect

Use TDB Figure II.C.2.a, b, or c, use reactor power (before trip), and burnup 4. and 8. above, to determine power defect.

_____% Δρ
10.

11. Calculate Xenon Reactivity

a. Current Xenon Worth (Use TDB Figure II.D.2. and hours since shutdown 3. above.)

_____% Δρ
11.A.

b. Xenon worth prior to shutdown (Use TDB Figure II.D.1.a and reactor power 4. above.)

_____% Δρ
11.B.

c. Change in Xenon worth due to shutdown.

(_____)% Δρ - (_____)% Δρ = (_____)% Δρ
11.b 11.a 11.c

12. Total Rod Worth

a. Regulating group worth based on burnup, See 8. above.

(Use TDB Figure II.B.2.a, b or c and CEA positions from 7. above.)

_____% Δρ
12.a.

b. Shutdown Group B worth based on burnup, see 8. above.

(Use TDB Section II.B.1.a. Select correct column.)

_____% Δρ
12.b.

c. Shutdown Group A worth based on burnup, see 8. above.

(Use TDB Section II.B.1.a. Select correct column.)

_____% Δρ
12.c.

d. Total rod worth

(Add 12.a., b. and c. above) _____% Δρ
12.d.

13. a. Enter rod positions if group rod withdrawal is required. (Enter N/A if not applicable.)

Shutdown Group A	_____	inches
Shutdown Group B	_____	inches
Regulating Group 1	_____	inches
Regulating Group 2	_____	inches
Regulating Group 3	_____	inches
Regulating Group 4	_____	inches

b. Enter the position if an individual rod is to be withdrawn.

Individual Rod Group _____ Rod Number_____

Inches withdrawn _____

(Enter N/A if not applicable.)

14. Reactivity for group or individual rod withdrawals:

(Enter N/A if not applicable.)

a. If shutdown Group A is withdrawn (Use TDB Figure II.B.1.A. and burnup, see 8. above. Select correct column.)

_____% Δρ
14.A.

b. If shutdown Group B is withdrawn (Use TDB Figure II.B.1.A. and burnup, see 8. above. Select correct column.)

_____% Δρ
14.B.

c. If regulating groups are withdrawn sequentially (Use TDB Figure II.B.2.a, b or c, and CEA positions from 13. above.) Based on burnup. See 8. above.

_____% Δρ
14.C.

d. If an individual regulating rod or shutdown rod is withdrawn, consult the Reactor Engineer to calculate its reactivity.

_____% Δρ
14.D.

e. Total rod withdrawal reactivities

Add 14.a., b., c. and d., as applicable.

_____% Δρ
14.E.

15. Inoperable Rod Reactivity Worth.

NOTE: If all rods are operable per Tech. Spec. 2.10.2(4) a., enter N/A.

Consult the Reactor Engineer to determine the reactivity of the entire rod(s). If unknown, enter a value from lines (1) thru (3) of TDB Figure II.B.1.b. (for each rod) pre-trip configuration. Based on burnup, see 8. above. Select correct column.

_____% Δρ
Total 15

16. Calculate total margin to critical

a. _____% Δρ + _____% Δρ + _____% Δρ
15. 14.e. 11.c.

+(_____% Δρ) - (_____% Δρ) - (_____% Δρ) = _____% Δρ
10. 12.D. 9.g. Total 16.a.

(Inoperable rod worth) + (Total rod withdrawal worth) + (Xenon worth)

+ (Power defect) - (Total rod worth) - (Worth boron change) - (Margin to criticality)

16. b. Add a 0.1% Δρ uncertainty

_____% Δρ + 0.1% Δρ = _____% Δρ
16.a. 16.b.

17. Determine the worth of the most reactive CEA <u>withdrawn</u>. (Use TDB II.B.1.b. with burnup, 8. and rod position, 13.)

_____
17

18. Calculate shutdown margin

a. _____ (17.) % Δρ + _____ (11.c.) % Δρ + _____ (10.) % Δρ

+(_____ (15.) % Δρ) - (_____ (12.D.) % Δρ) - (_____ (9.g.) % Δρ) = _____ (Total 18.a.) % Δρ

(Worth of most reactive CEA) + (Xenon worth) + (Power defect) + (Inoperable rod worth) - (Total rod worth) - (Worth boron conc. change) = (Shutdown margin)

b. Add a 0.1% Δρ for uncertainty

_____ (18.a.) % Δρ + 0.1% Δρ = _____ (18.b.) % Δρ

19. Calculate the difference from the required shutdown margin. (N/A if not applicable.)

a. For hot shutdown (see 6. above).

(_____ (18.b.) % Δρ) + 4.0% Δρ = _____ (19.) % Δρ

b. For cold shutdown (see 6. above).

(_____ (18.b.) % Δρ) + 3.0% Δρ = _____ (19.) % Δρ

If 19 is $\leq$ 0, shutdown margin is adequate.

If 19 is > 0, use OI-ERFCS-1, Procedure 36 to determine the number of gallons of acid to add.

Fort Calhoun Station
Unit No. 1

TDB-II

TECHNICAL DATA BOOK PROCEDURE

Title: REACTIVITY CURVES

Setpoint/Procedure
Form Number (FC-68): 38234

Reason for Change: Update the reactivity curves for Cycle 14 operation.

Contact Person: Keith Voss

REACTIVITY CURVES

Critical Boron Concentration

Critical Boron Concentration (CBC) data represent the boron concentration (ppm) necessary for reactor criticality. The Cycle 14 CBC versus burnup show a different shape compared to previous cycle's shapes. The CBCs use the base assumptions that the core inlet temperature follows the T-average program. Xenon is at equilibrium and equilibrium Samarium effects are included as a function of burnup.

Figure II.A.1.a - HFP Critical Boron Concentration versus Burnup (^{MWD}/MTU)

Critical Boron Concentration (CBC) at Hot Full Power (HFP) shows the boron concentration (ppm) required for reactor critically at HFP. The Cycle 14 HFP CBC versus burnup shows that after reaching HFP equilibrium Xenon, operators will need to borate for the approximately the first 2¼ months for power level control. After the first 2¼ months in the cycle, the CBC will behave as in previous cycles and decrease in a linear fashion. This figure is used with OP-ST-RX-0001, Reactor Anomalies. Unexpected deviations from this curve that require a curve revision are addressed in RE-ST-PX-0006, Normalization of Computed Boron Concentration versus Burnup Curve.

Figure II.A.1.b - HZP Critical Boron Concentration versus Burnup (^{MWD}/MTU)

Critical Boron Concentration (CBC) at Hot Zero Power (HFP) shows the boron concentration (ppm) required for reactor criticality at HZP (532°F). The CBC is based on Equilibrium Samarium, Plutonium buildup and No Xenon which is consistent with continuous full power operation. This figure is used in TDB Procedure TDB-V.1.b, Estimated Critical Conditions Worksheet.

Figure II.A.2.a thru 11.A.2.d - Critical Boron Concentration versus Percent Power

Critical Boron Concentrations (CBC) versus Power shows the boron concentration (ppm) required for reactor criticality at various power levels and burnups. The CBC is based on Equilibrium Xenon and Samarium. The figures are broken down for burnup ranges of 0 to 2,000 ^{MWD}/MTU, 2,000 to 6,000 ^{MWD}/MTU, 6,000 to 10,000 ^{MWD}/MTU and 10,000 to 15,000 ^{MWD}/MTU for clarity. These ranges were chosen because the CBC will be increasing for the first 2¼ months of Cycle 14. These figures are made available to operational guidance and information.

Boron Concentration for 4% and 3% Shutdown Margin versus Burnup (MWD/MTU)

The following figures for minimum Boron Concentration required for 4% or 3% Shutdown Margin are used to ensure compliance with Technical Specifications 2.10(1) and 2.10(2). For Cycle 14 a large number of temperatures have been incorporated to give operations more flexibility in meeting the minimum boron concentration during cooldown. In the cooldown process each successive figure's minimum boron value should be achieved prior to cooling down to the next temperature. Two curves are shown on each figure allowing CEA group N to either be in or out. These curves exhibit the same shapes as the CBC versus burnup curves. The figures are based on No Xenon, All rods (ARI) and include uncertainties. These figures are used in performing TDB Procedure TDB-V.9, Shutdown Margin Worksheet, in conjunction with OP-ST-RX-002, Shutdown Margin Verification During Hot Shutdown, Cold Shutdown or Refueling.

Figure II.A.3.a - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure is the first in the series, providing minimum boron concentration required at 532°F.

Figure II.A.3.b - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 515°F.

Figure II.A.3.c - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 500°F.

Figure II.A.3.d - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 475°F.

Figure II.A.3.e - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 450°F.

Figure II.A.3.f - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 400°F.

Figure II.A.3.g - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 350°F.

Figure II.A.3.h - Boron Concentration for 4% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required above 210°F.

Figure II.A.3.i - Boron Concentration for 3% Shutdown Margin versus Burnup

This figure provides minimum boron concentration required when temperature is below 210°F. This is a step change in the minimum shutdown margin required utilizes Technical Specification 2.10(2) and allows the shutdown margin to be reduced from 4% to 3%.

Figure II.A.3.i - Boron Concentration for 1% Shutdown Margin versus Burnup

This figure provides minimum born concentration required above 68°F.

Inverse Boron Worth

Inverse Boron Worth is the reciprocal of the boron reactivity worth, i.e. boron concentration corresponding to 1%Δk/k reactivity. IBW versus burnup at Hot Full Power (HFP), and Hot Zero Power (HZP) are presented in this section.

Figure II.A.4 - Inverse Boron Worth vs. Burnup

This Figure shows how Inverse Boron Worth varies over the burnup range of Cycle 14 operations. The non-linear aspect of the graphs in the early part of the cycle is due to the large IFBA loading in the core that is burned out in the first 3000 MWD/MTU of operation. Curves on this graph represent the value at HFP and HZP.

CEA Bank Worths

This section of figures deals with the reactor effects of the CEA's inserted into the core. Figures in this section deal with CEA group insertion into the core, inoperable rod effect on shutdown margin, and sequential group insertion for Groups 1-4. All figures are done at HZP and reflect no Xenon presence. In general, 0 MWD/MTU figures should be utilized between 0 and 3,500 MWD/MTU, 7,000 MWD/MTU figures should be used between 3,500 and 11,000 MWD/MTU, and 15,000 MWD/MTU figures should be used between 11,000 and 15,000 MWD/MTU when not interpolating.

Figure II.B.1.a - Cycle 14 CEA Group Worths in %Δp When Inserted Sequentially

This figure gives the worth of each CEA Group in %Δp when inserted in a sequential manner for 3 timepoints in Cycle 14. This information in this figure is not applicable if the CEA groups are out of the sequence listed.

Figure II.B.1.b - Cycle 14 Reduction in Shutdown Margin or Stuck CEA(s) Worth

This figure gives the Loss of Shutdown Margin when there are known inoperable CEAs. Each CEA is listed independently for subtraction from the Total Shutdown Margin in the event of its inoperability. Values are listed for BOC (0 MWD/MTU) and EOC (15,000 MWD/MTU).

Figure II.B.2.a - Sequential Rod Worth vs Rod Position at 0 MWD/MTU

This figure gives the worth of the rods inserted in the core at BOC conditions for Groups 1-4.

Figure II.B.2.b - Sequential Rod Worth vs Rod Position at 7,000 MWD/MTU

This figure gives the worth of the rods inserted in the core at MOC conditions for Groups 1-4.

Figure II.B.2.c - Sequential Rod Worth vs Rod Position at 15,000 MWD/MTU

This figure gives the worth of the rods inserted in the core at EOC conditions for Groups 1-4.

Figure II.B.3.a - Group 4 Integral Rod Worth at 0 MWD/MTU

This figure gives the worth of Group 4 inserted in the core at BOC conditions for CEA Group 4.

Figure II.B.3.b - Group 4 Integral Rod Worth at 7,000 MWD/MTU

This figure gives the worth of Group 4 inserted in the core at MOC conditions for CEA Group 4.

Figure II.B.3.c - Group 4 Rod Worth vs Rod Position at 15,000 MWD/MTU

This figure gives the worth of Group 4 inserted in the core at EOC conditions for CEA Group 4.

Excess Reactivity versus Burnup

Figure II.C.1 - Excess Reactivity versus Burnup

Excess reactivity is a measure of the amount of energy in the reactor core above and beyond what is required to achieve criticality at full power with equilibrium Xenon and All Rods Out (ARO). The excess reactivity versus burnup curve is used in performing OP-ST-RX-0001, Reactivity Anomalies, as per Technical Specification 3.10(1)b. The overall core reactivity balance shall demonstrate agreement with 1.0%Δk/k. This curve accounts for all reactivity effects in the core at HFP, ARO.

Power Defect versus Power

Power Defect versus power shows the power defect from 0 to 100% power for specific burnup ranges. The assumptions used at each power level in determing the power defect are CBC, equilibrium Xenon and ARO. Power Defect is used in OP-ST-RX-0001, Reactivity Anomalies; OP-ST-RX-0002, Shutdown Margin Determination, and TDB Procedure TDB-V.1.b, Estimated Critical Conditions Worksheet.

Figure II.C.2.a - Power Defect versus Power (0 to 6,000 MWD/MTU

This figure provides the power defect versus power for three burnup ranges: BOC to 4,000 MWD/MTU; 4,000 to 5,000 MWD/MTU and 5,000 to 6,000 MWD/MTU.

Figure II.C.2.b - Power Defect versus Power (6,000 to 11,000 MWD/MTU)

This figure provides the power defect versus power for five burnup ranges: 6,000 to 7,000 MWD/MTU; 7,000 to 8,000 MWD/MTU; and 8,000 to 9,000 MWD/MTU; 9,000 to 10,000 MWD/MTU and 10,000 to 11,000 MWD/MTU.

Figure II.C.2.c - Power Defect versus Power (11,000 to 15,000 MWD/MTU)

This figure provides the power defect versus power with four burnup ranges: 11,000 to 12,000 MWD/MTU; 12,000 to 13,000 MWD/MTU; and 13,000 to 14,000 MWD/MTU; and 14,000 to 15,000 MWD/MTU.

Moderator Temperature Coefficient

Figure II.C.4 - Moderator Temperature Coefficient vs Burnup

This figure shows the change in core reactivity due to changes in moderator temperature. This is used to calculate changes due to inlet temperature variations and other changes to the average moderator temperature, such as changes in turbine load.

Xenon Reactivity Worths

The figures in this section deal with the effect of the most significant fission product, Xenon-135 and its effect on core reactivity during equilibrium operation at all power levels, full power operation for all points during the cycle, and for 80 hours after the time of trip for different power levels. These figures assume equilibrium conditions with the exception of the Xenon worth after tip which assumes equilibrium Xenon prior to trip. These figures are used in TDB Procedure TDB-V.1.b, Estimated Critical Conditions Worksheet.

Figure II.D.1.a - Equilibrium Xenon Reactivity vs Percent Power

This figure provides the reactivity worth for the Xenon present in the core for equilibrium conditions at all power levels for three timepoints during the cycle: 0 MWD/MTU; 7,000 MWD/MTU; and 15,000 MWD/MTU.

Figure II.D.1.b - HFP Equilibrium Xenon Worth vs Burnup

This figure provides the reactivity worth for the Xenon at HFP for any burnup during the cycle. It would also be useful for scaling other Xenon worths to a particular burnup in cycle.

Figure II.D.2 - Xenon Worth After Trip (At 100%, 80%, 60%, 40%, and 20% power)

This figure provides the reactivity worth for Xenon after a reactor trip from five different power levels (100%, 80%, 60%, 40%, and 20%) at 7,000 MWD/MTU. This timepoint was chosen to best represent the entire cycle. Other burnup points can be approximated by scaling the value at a particular time to the ratio of HFP Equilibrium Xenon Worth between the timepoint of interest and 7,000 MWD/MTU.

Figure II.A.1.a

Cycle 14 Critical Boron Concentration vs Burnup

(ARO, Hot Zero Power, NO Xenon)

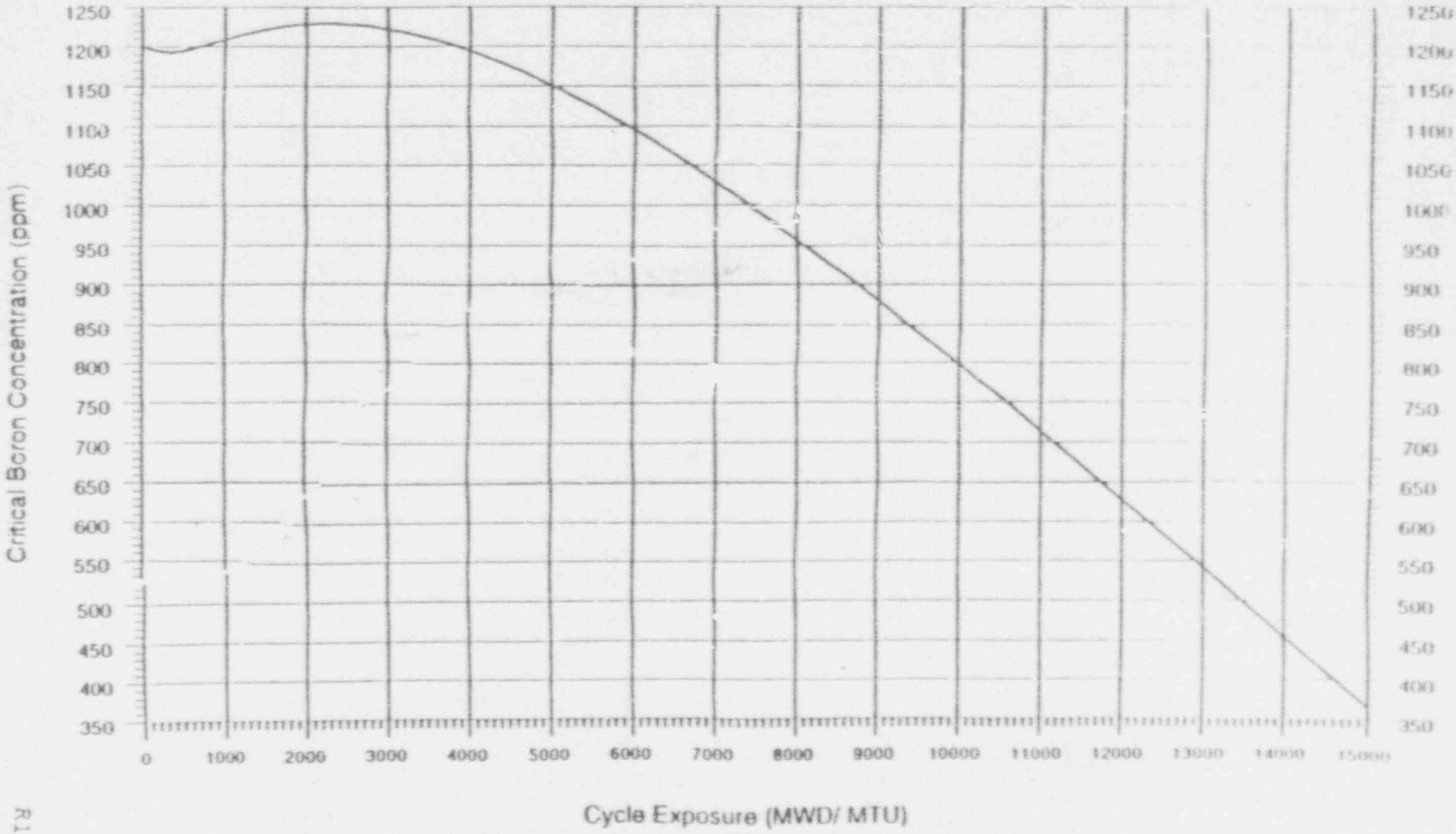


Figure II.A.1.b

Cycle 14 Critical Boron Concentration vs Burnup

(ARO, Hot Full Power, Equilibrium Xenon)

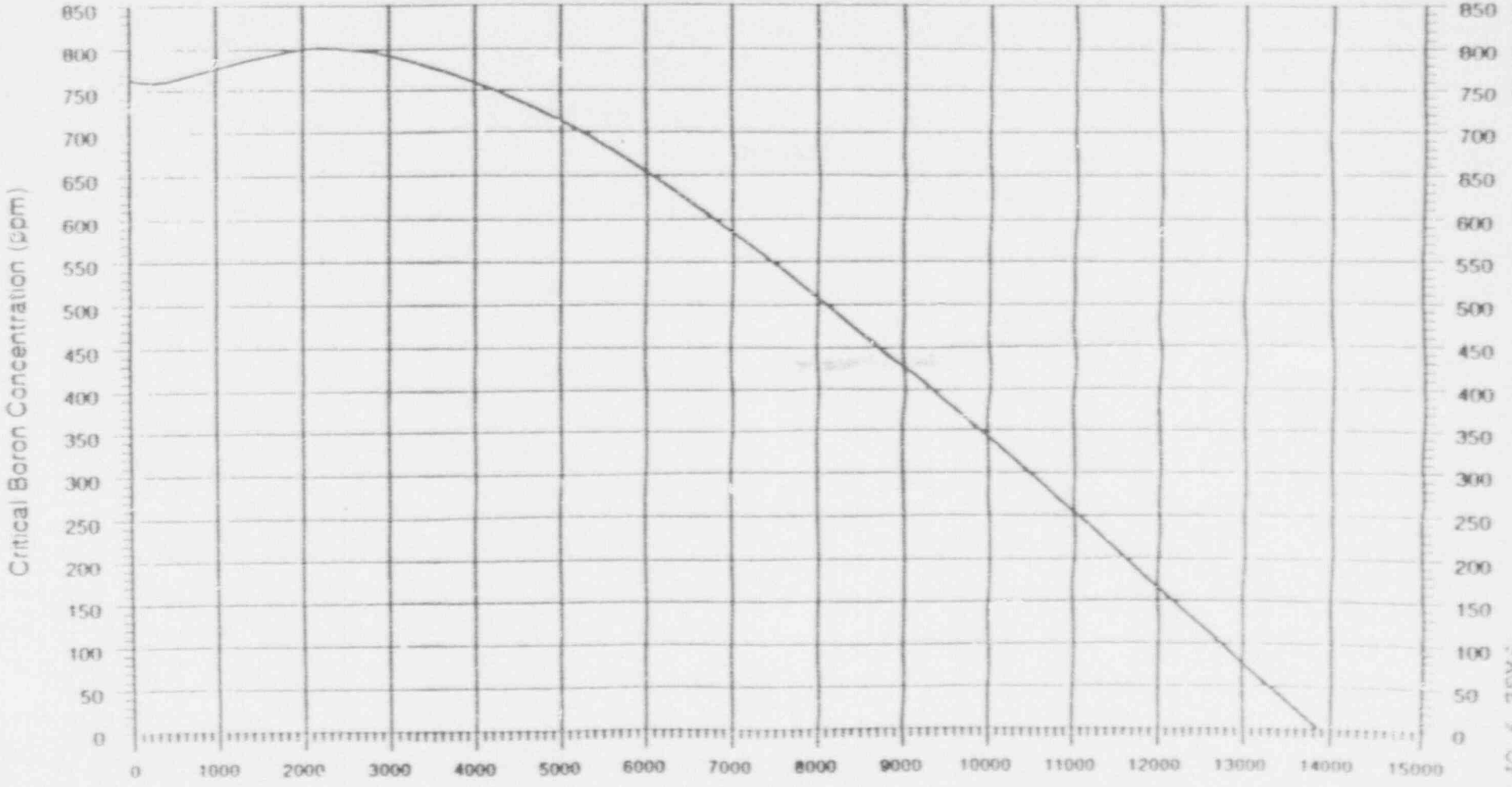


Figure II.A.2.a

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

BOC to 2,000 MWD/MTU

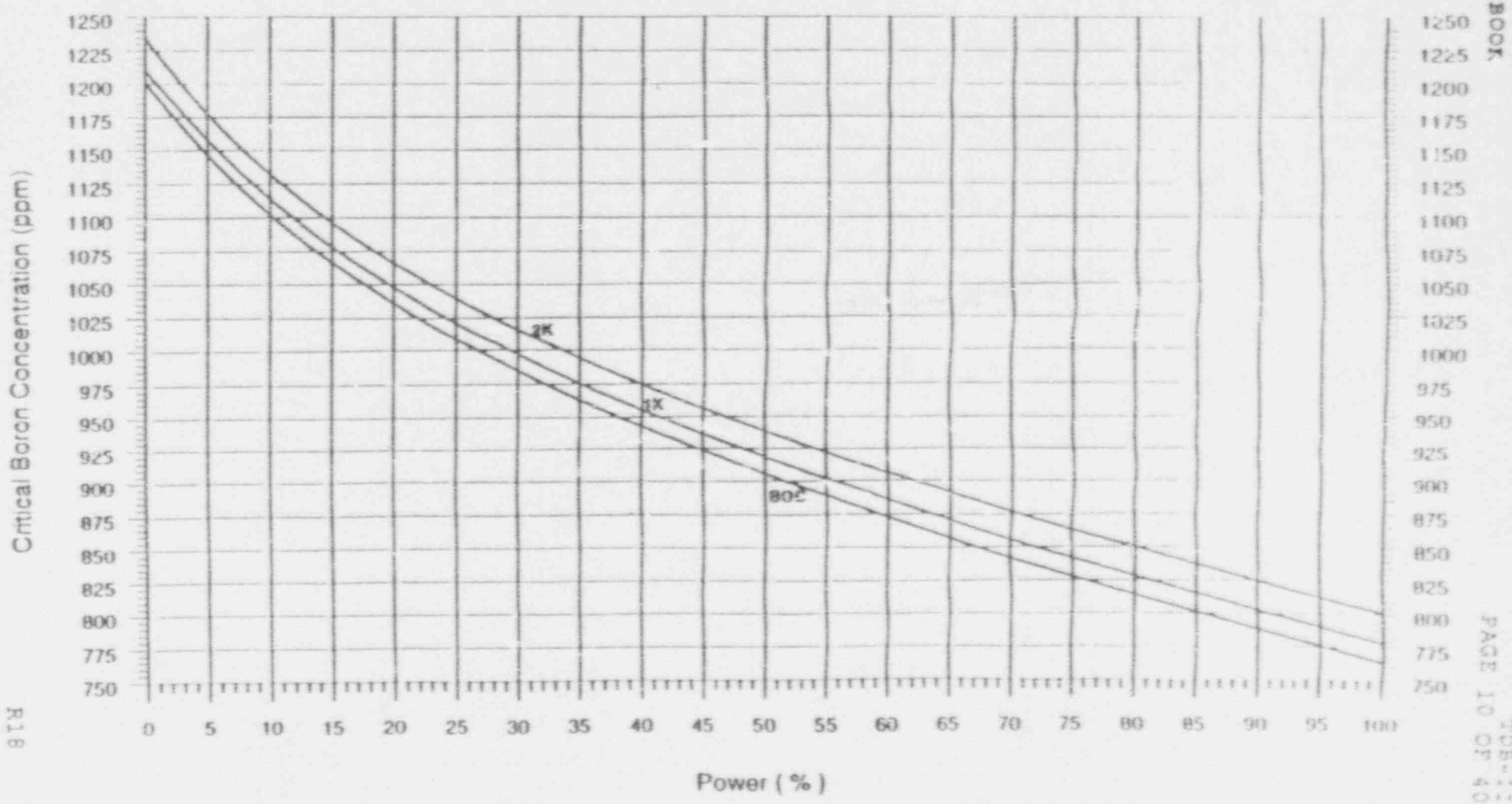


Figure II.A.2.b

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

2,000 MWD/MTU to 6,000 MWD/MTU

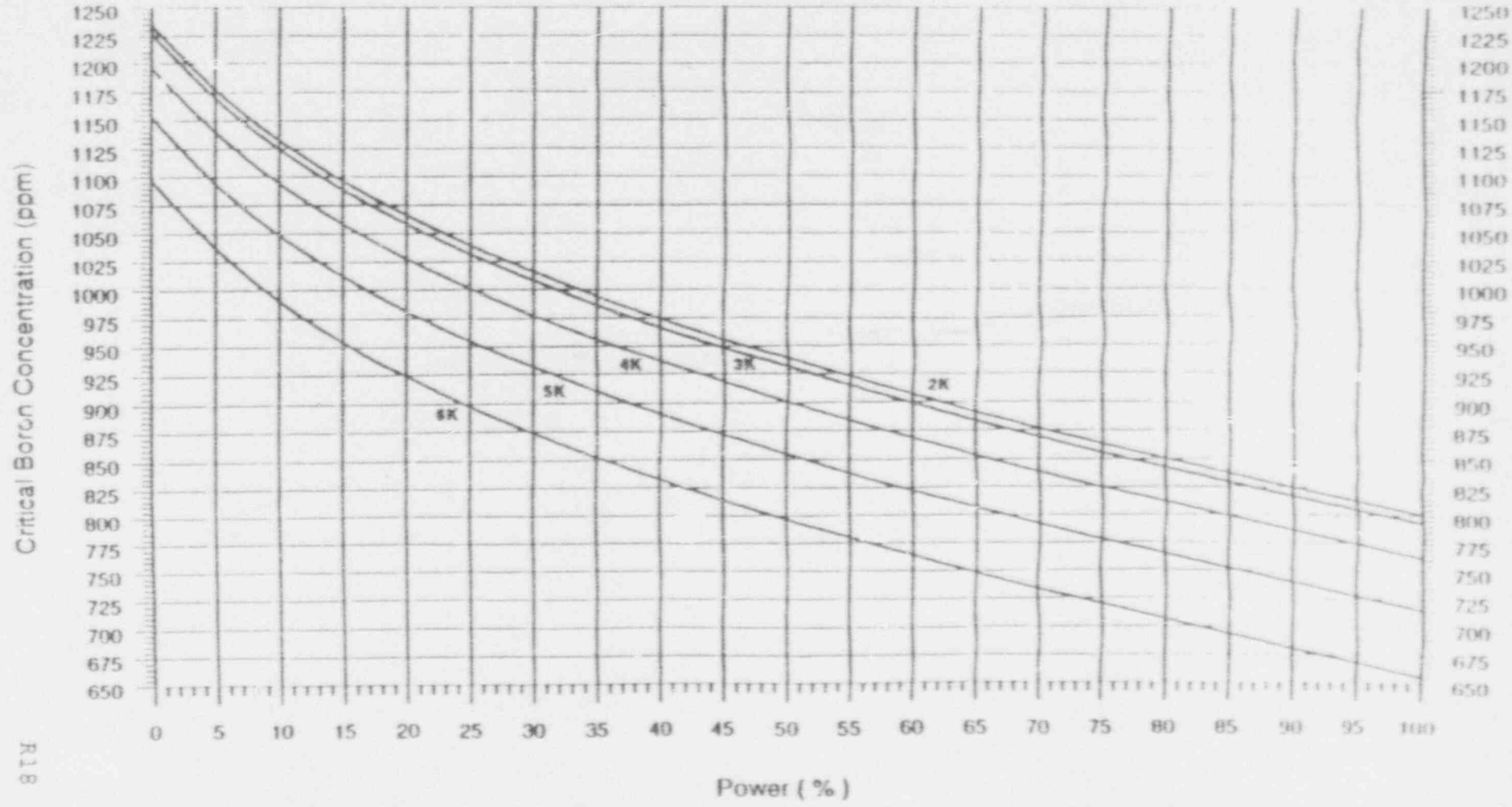


Figure II.A.2.c

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

6,000 MWD/MTU to 10,000 MWD/MTU

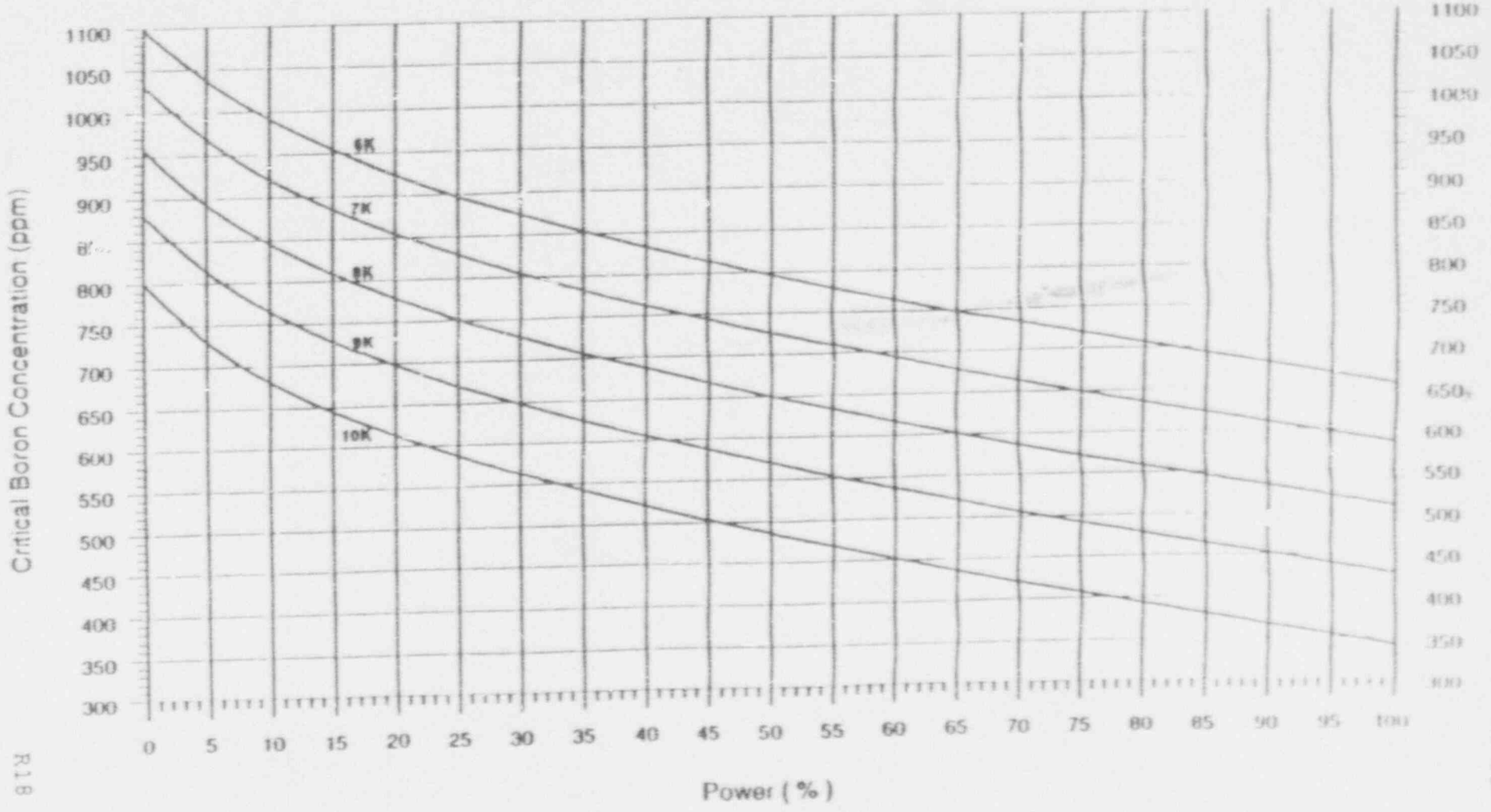


Figure II.A.2.d

Cycle 14 Critical Boron Concentration vs Power

(ARO, Equilibrium Xenon)

10,000 MWD/MTU to 15,000 MWD/MTU

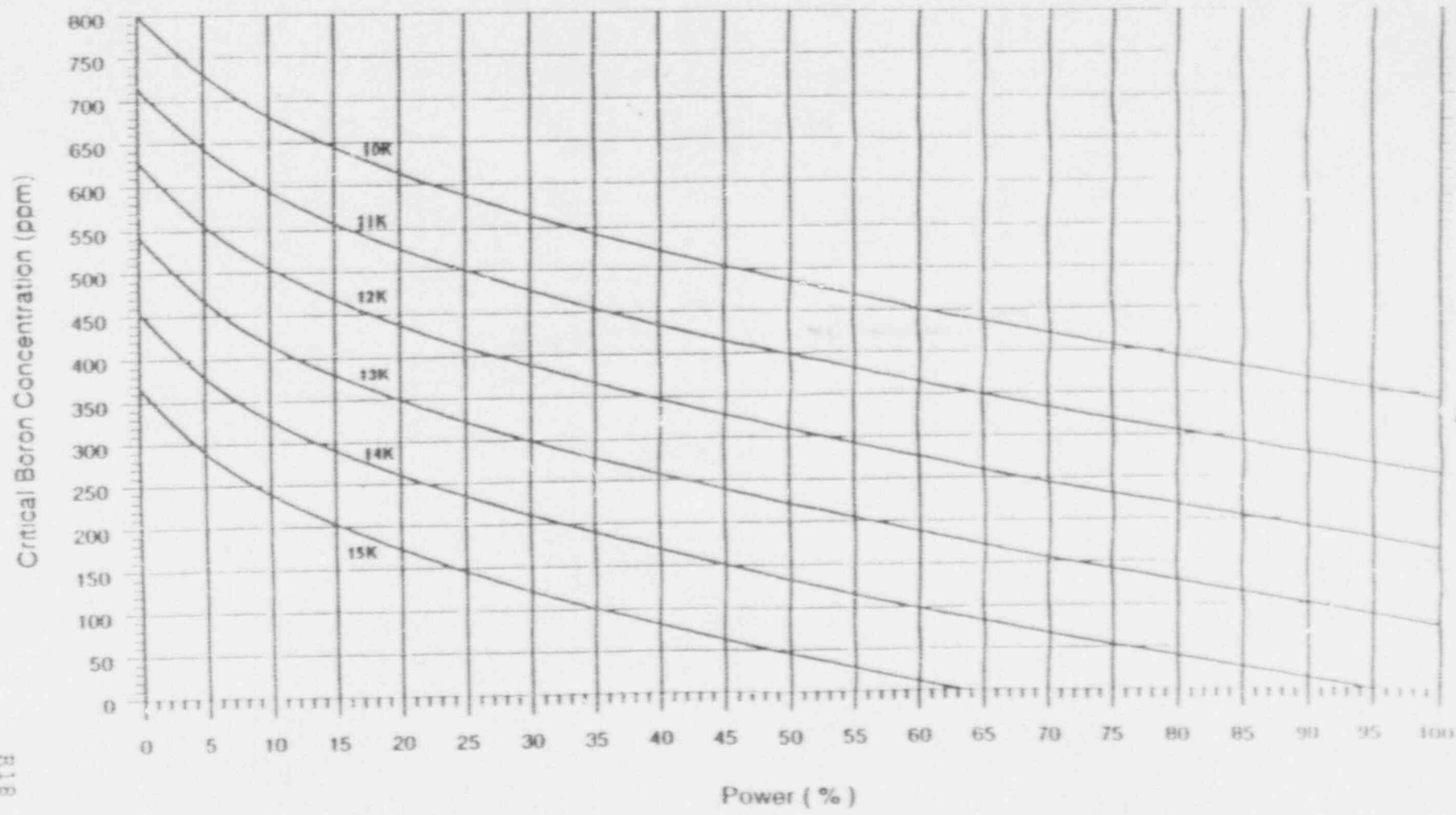


Figure II.A.3.a

Cycle 14 Minimum Boror Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 532 Degrees F, Equilibrium Samarium)

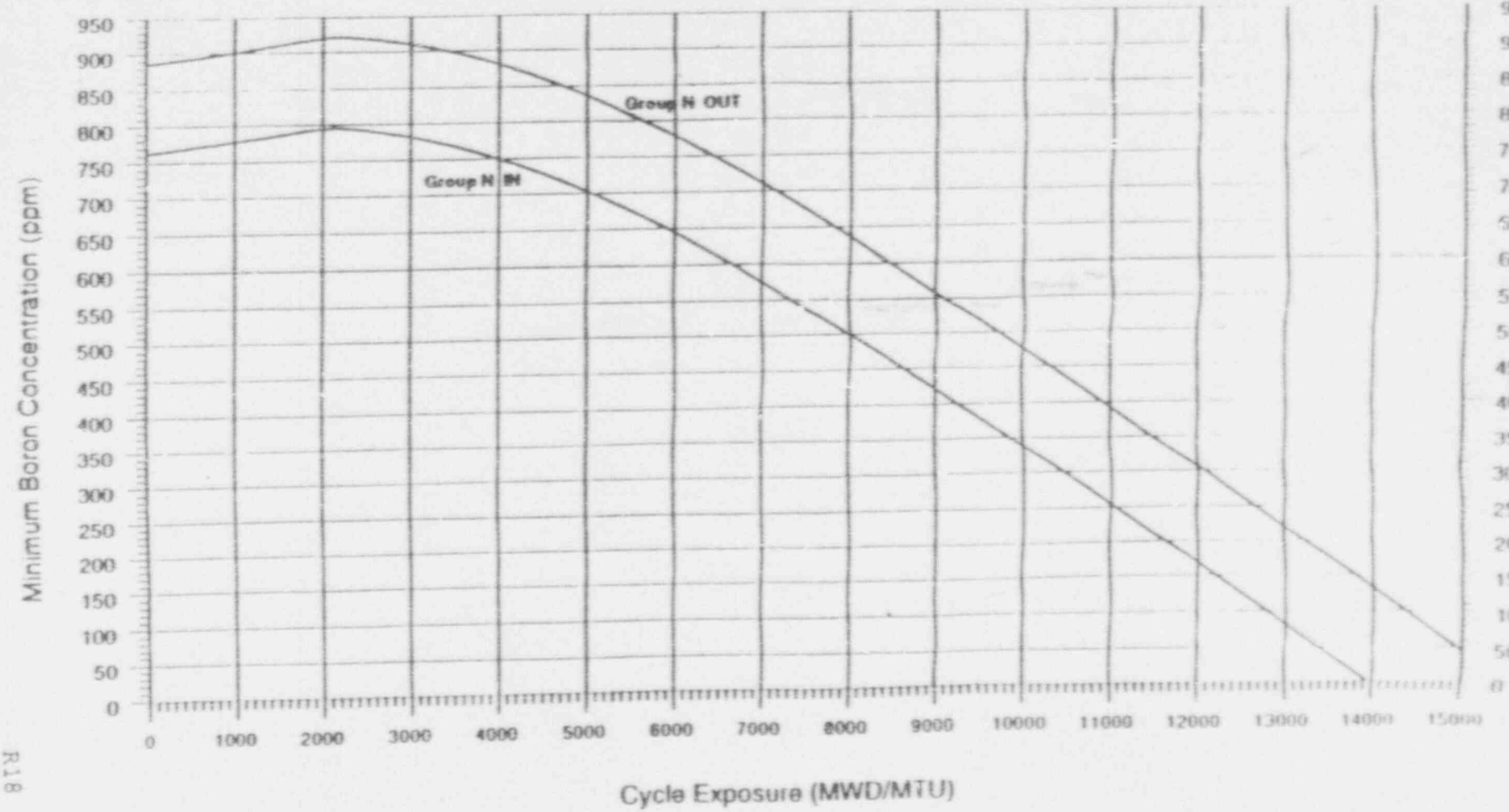


Figure II.A.3.b

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 515 Degrees F, Equilibrium Samarium)

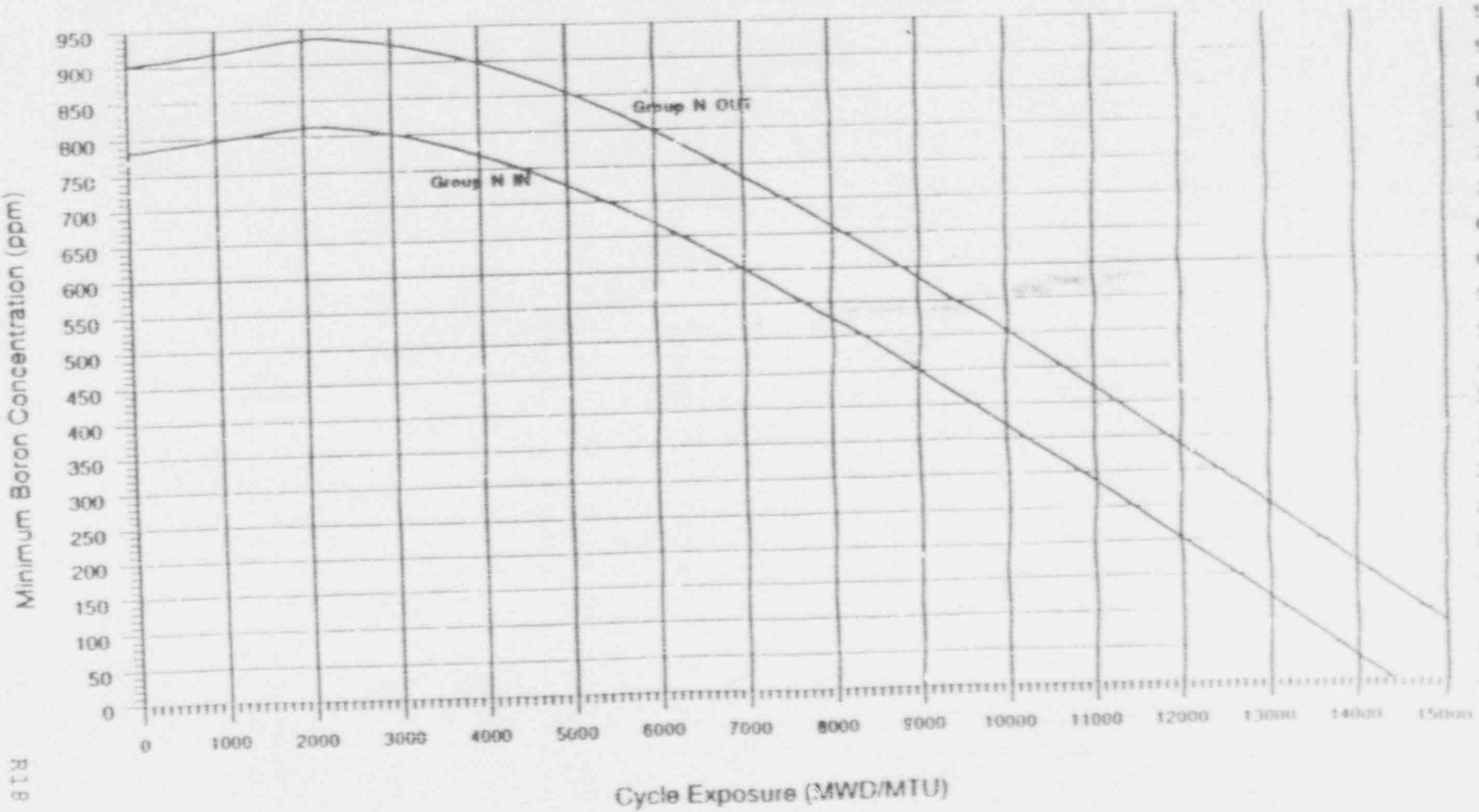


Figure II.A.3.c

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 500 Degrees F, Equilibrium Samarium)

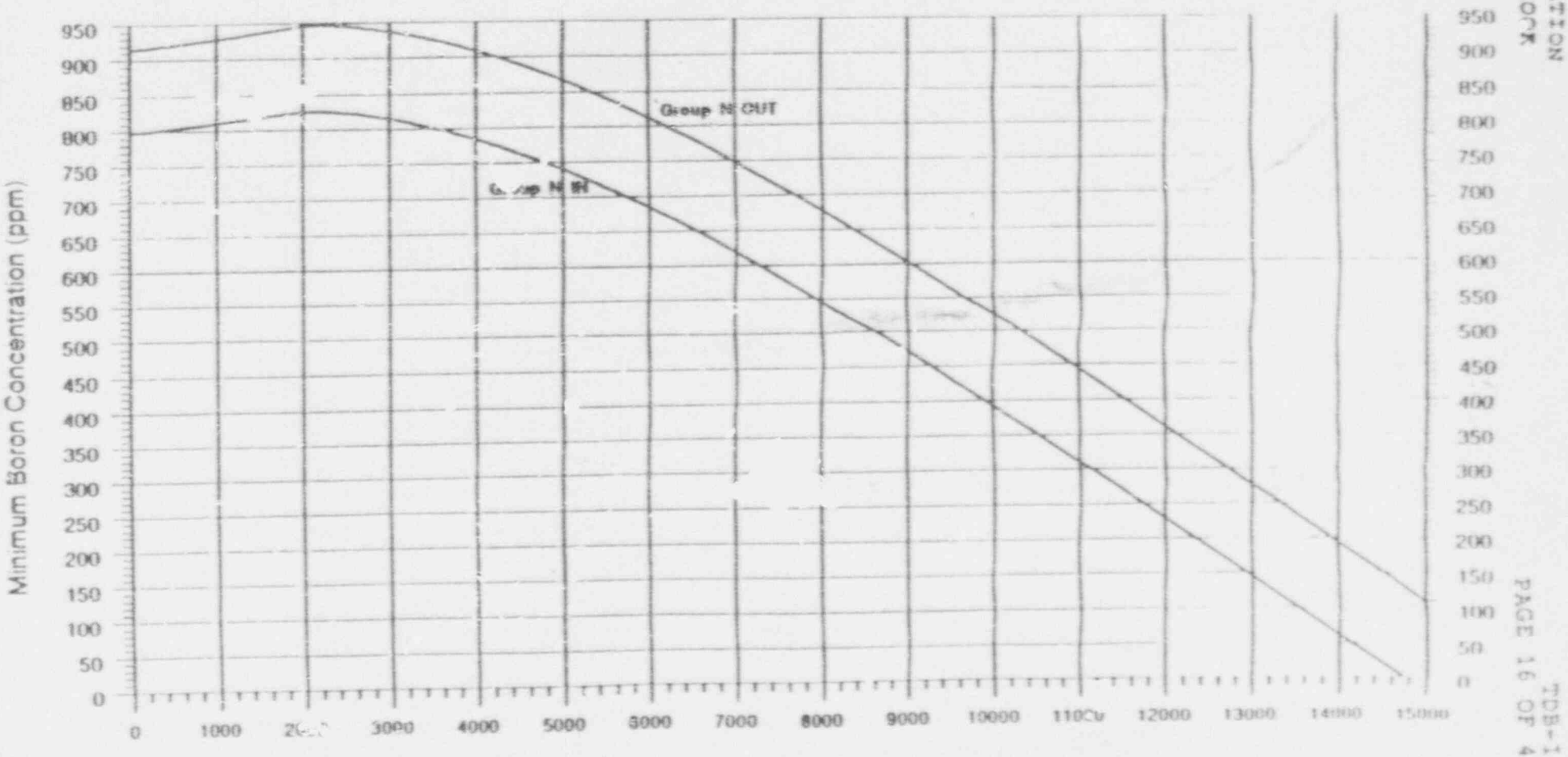


Figure II.A.3.d

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 475 Degrees F, Equilibrium Samarium)

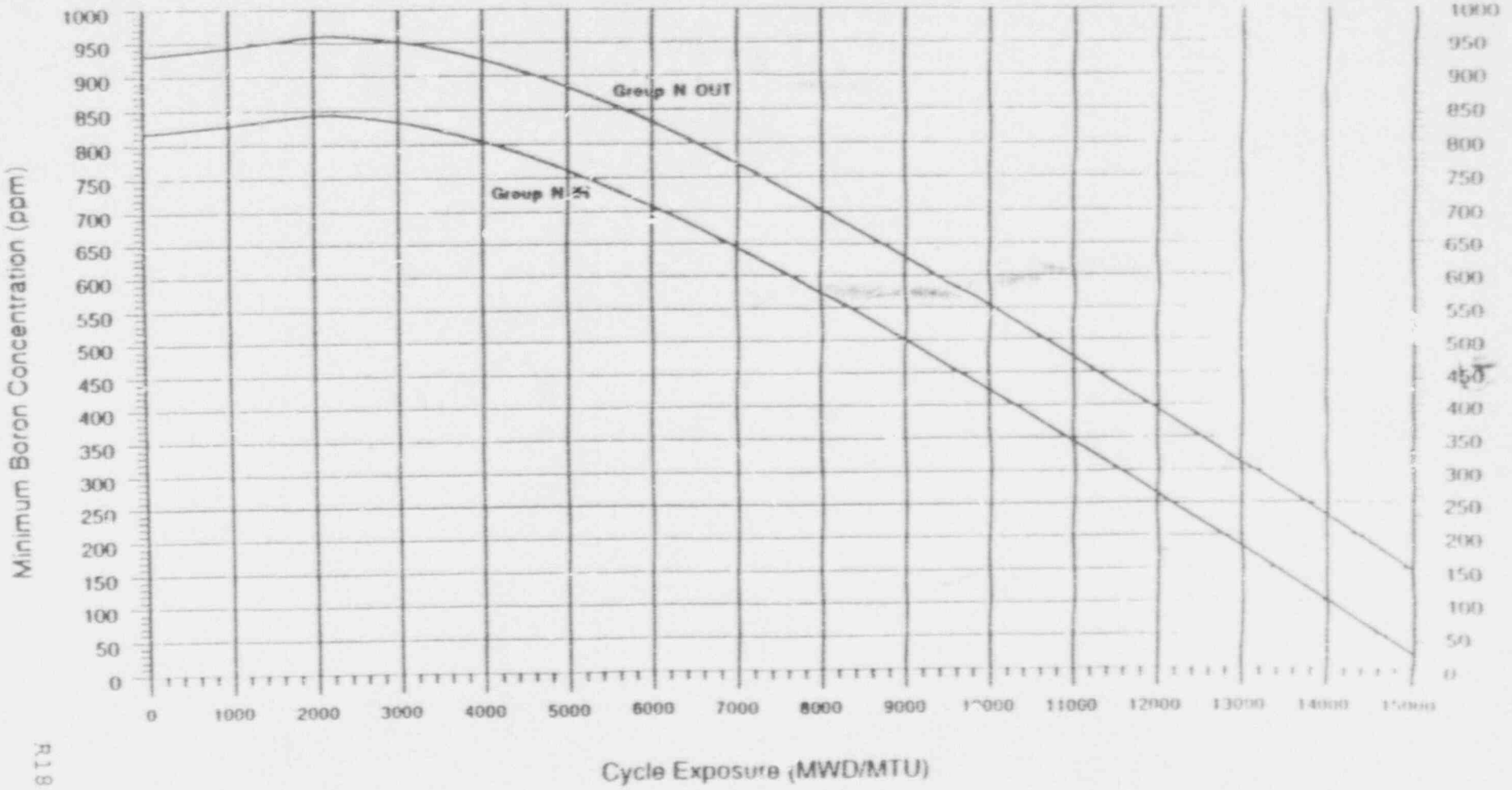


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Figure II.A.3.e

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 450 Degrees F, Equilibrium Samarium)

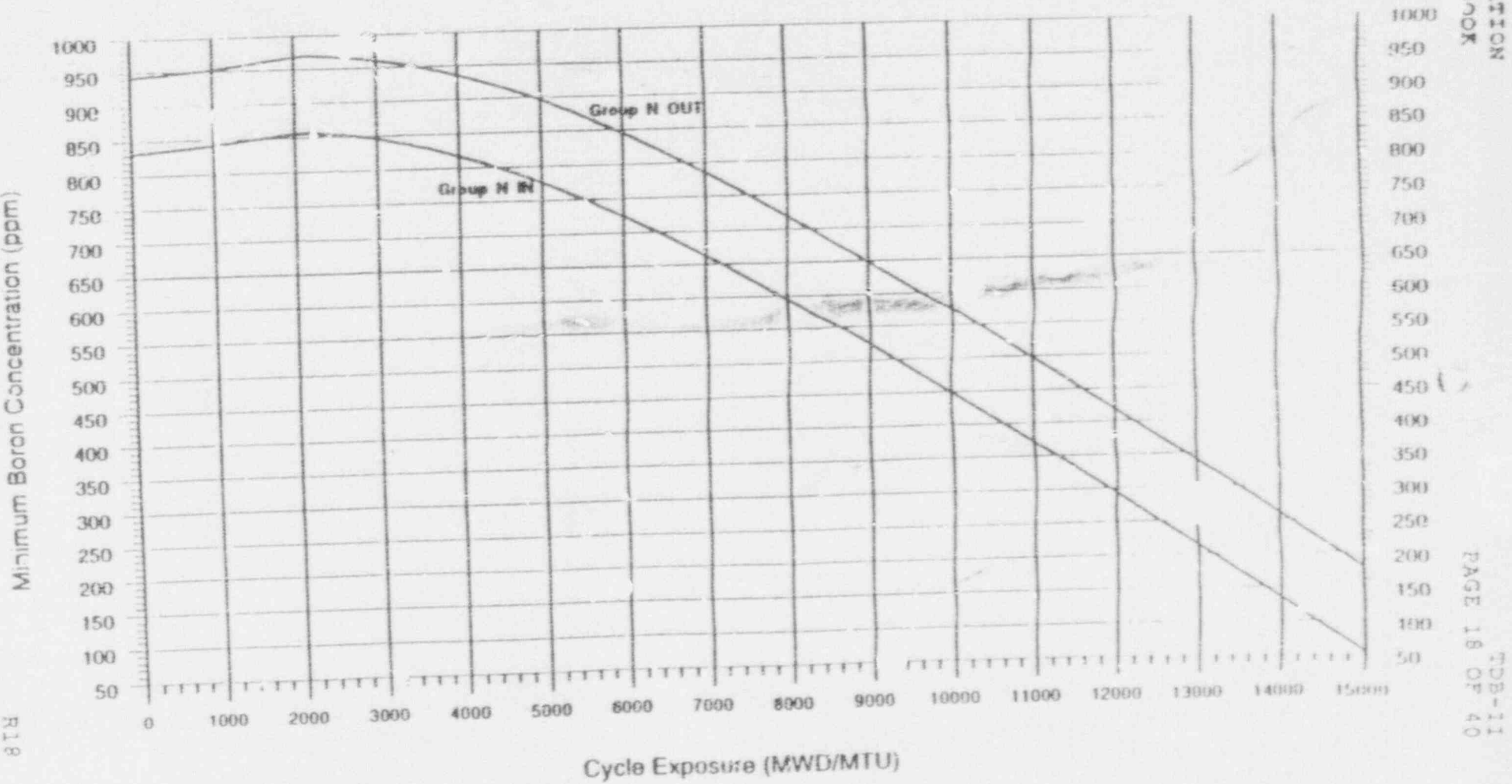

Figure II.A.3.f

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 400 Degrees F, Equilibrium Samarium)

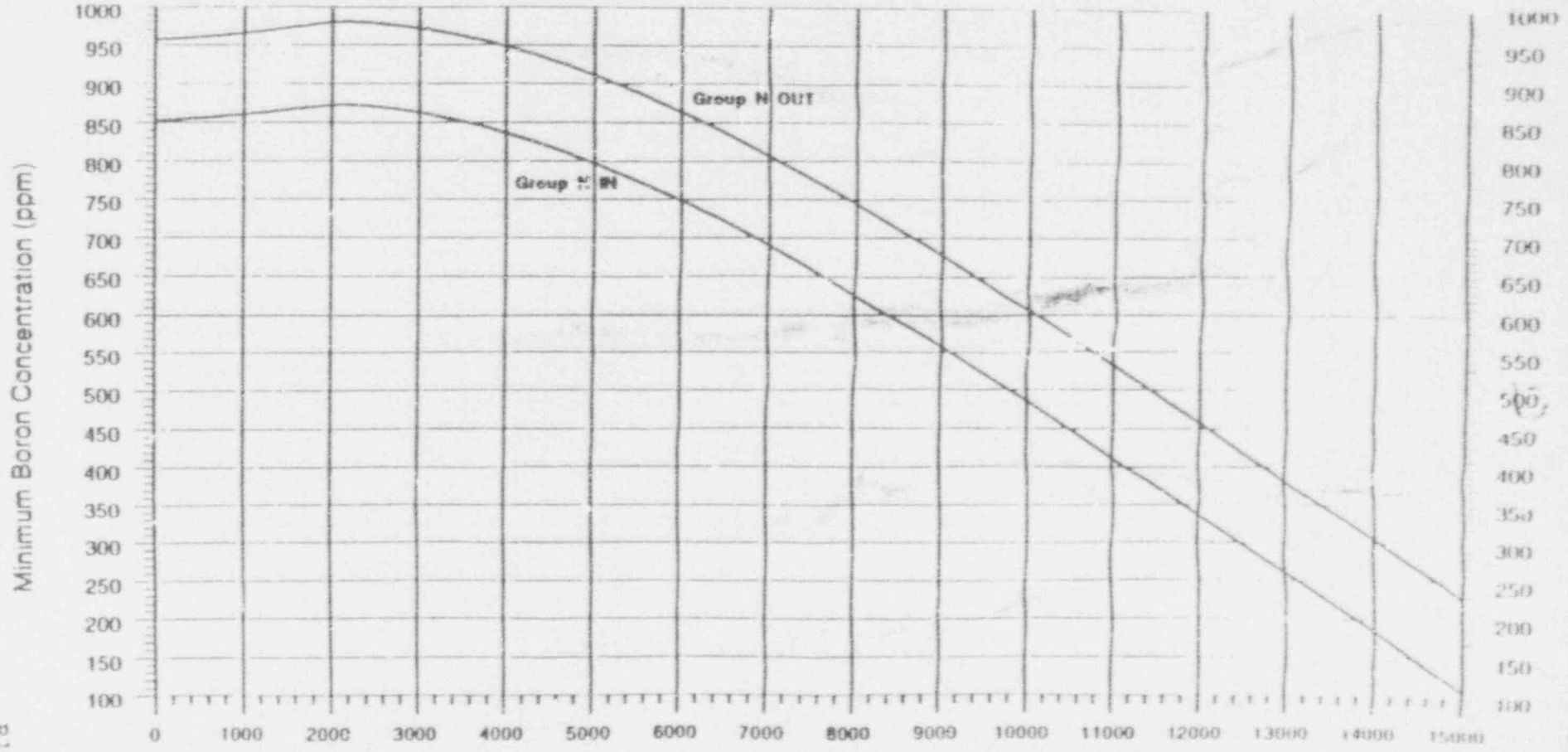

Figure II.A.3.g

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 350 Degrees F, Equilibrium Samarium)

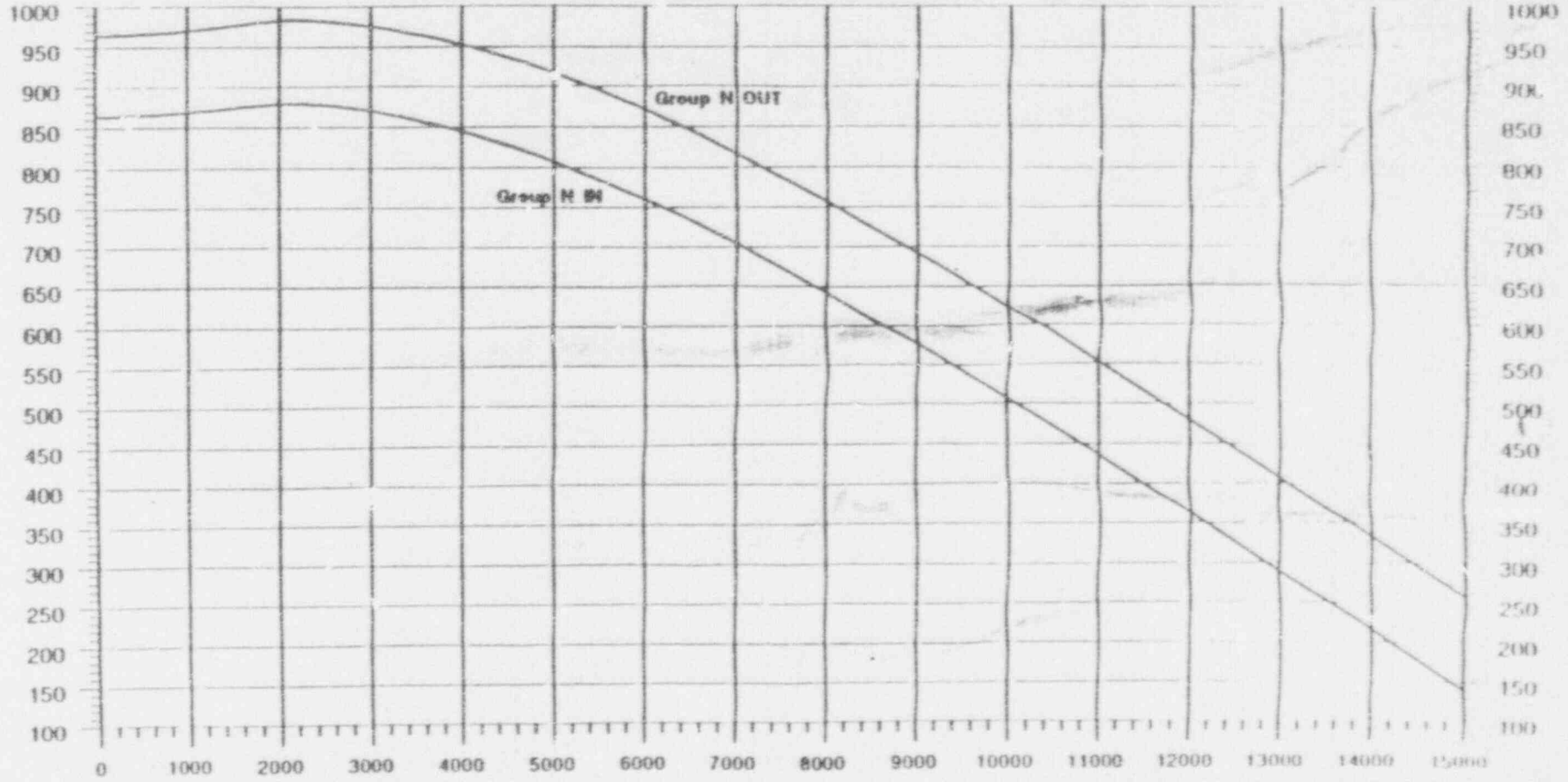

Figure II.A.3.h

Cycle 14 Boron Concentration for 4% Shutdown Margin vs Burnup

(ARI, Zero Power - 210 Degrees F, Equilibrium Samarium)

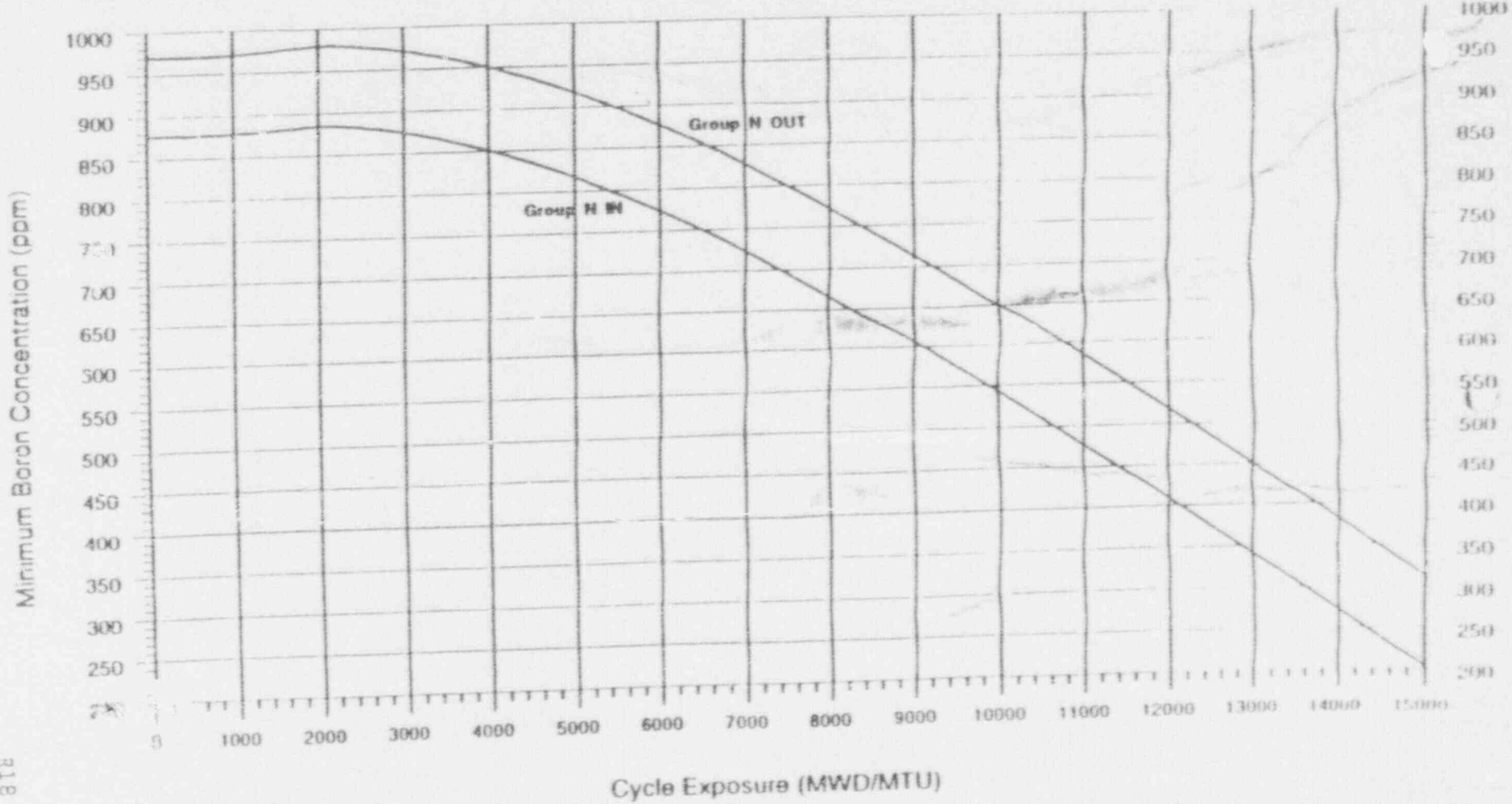

Figure II.A.3.i

Cycle 14 Boron Concentration for 3% Shutdown Margin vs Burnup

(ARI, Zero Power - 210 Degrees F, Equilibrium Samarium)

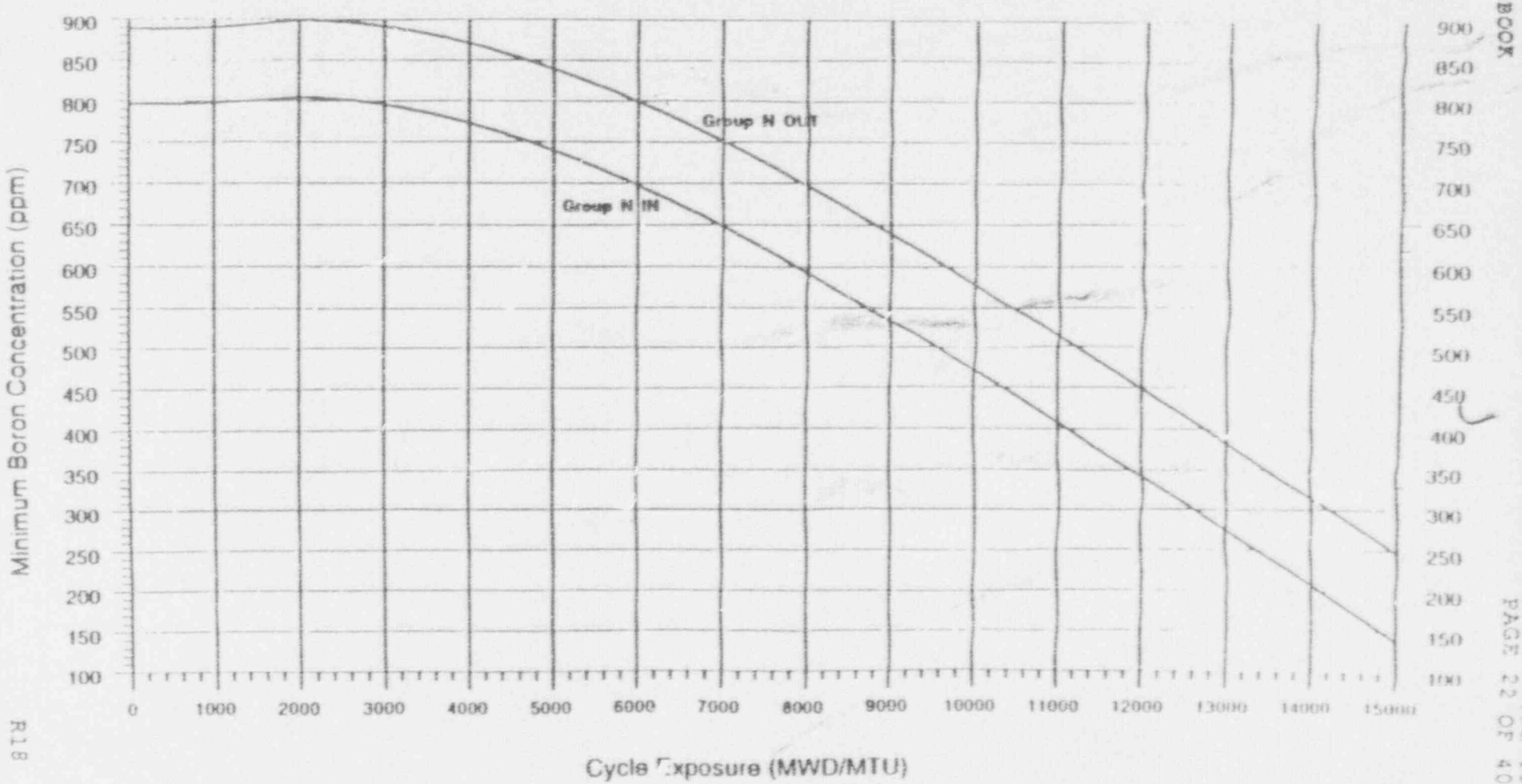

Figure II.A.3 j

Cycle 14 Boron Concentration for 3% Shutdown Margin vs Burnup

(ARI, Zero Power - 68 Degrees F, Equilibrium Samarium)

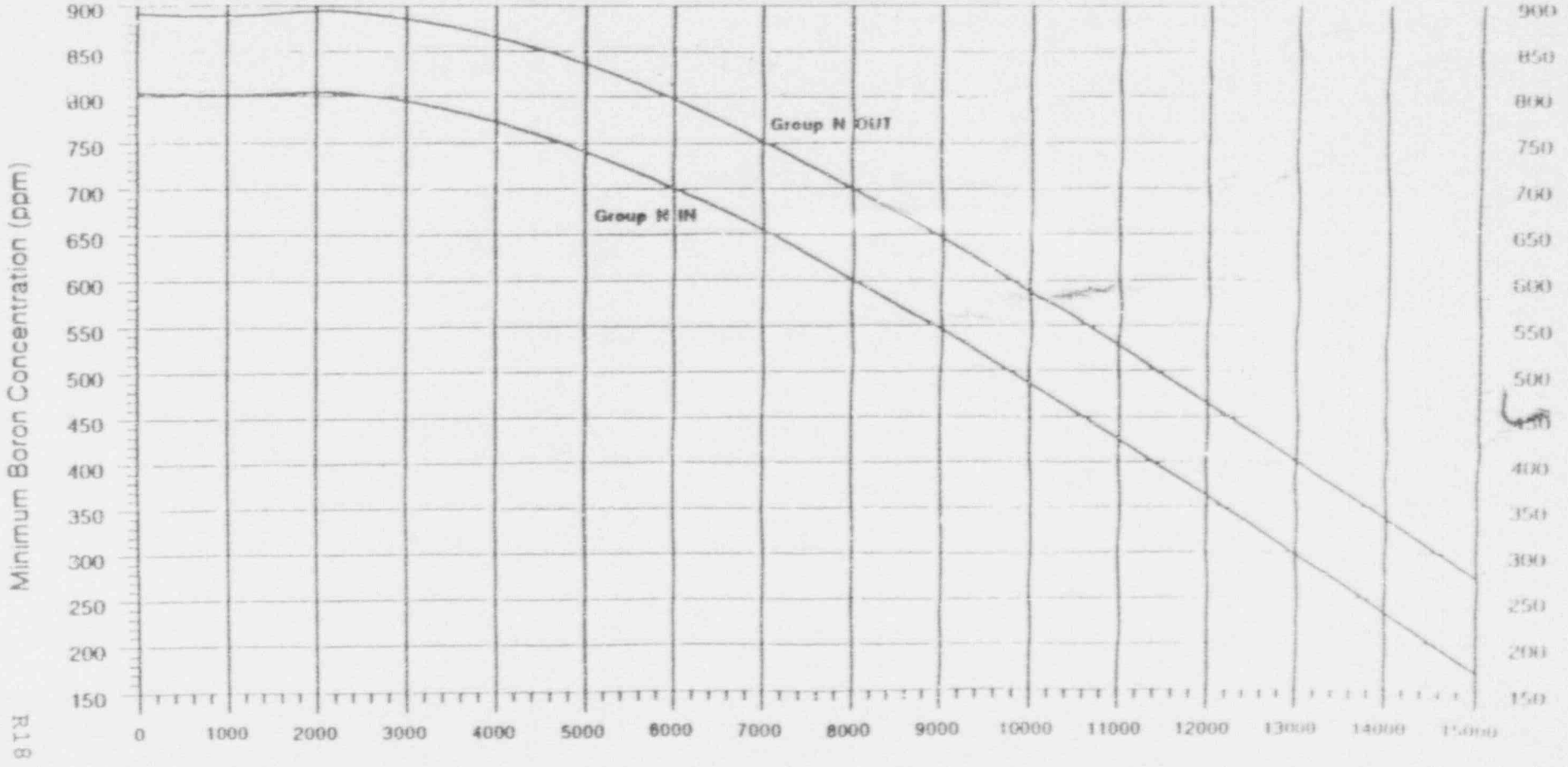

Figure II.A.4

Cycle 14 Inverse Boron Worth vs Burnup

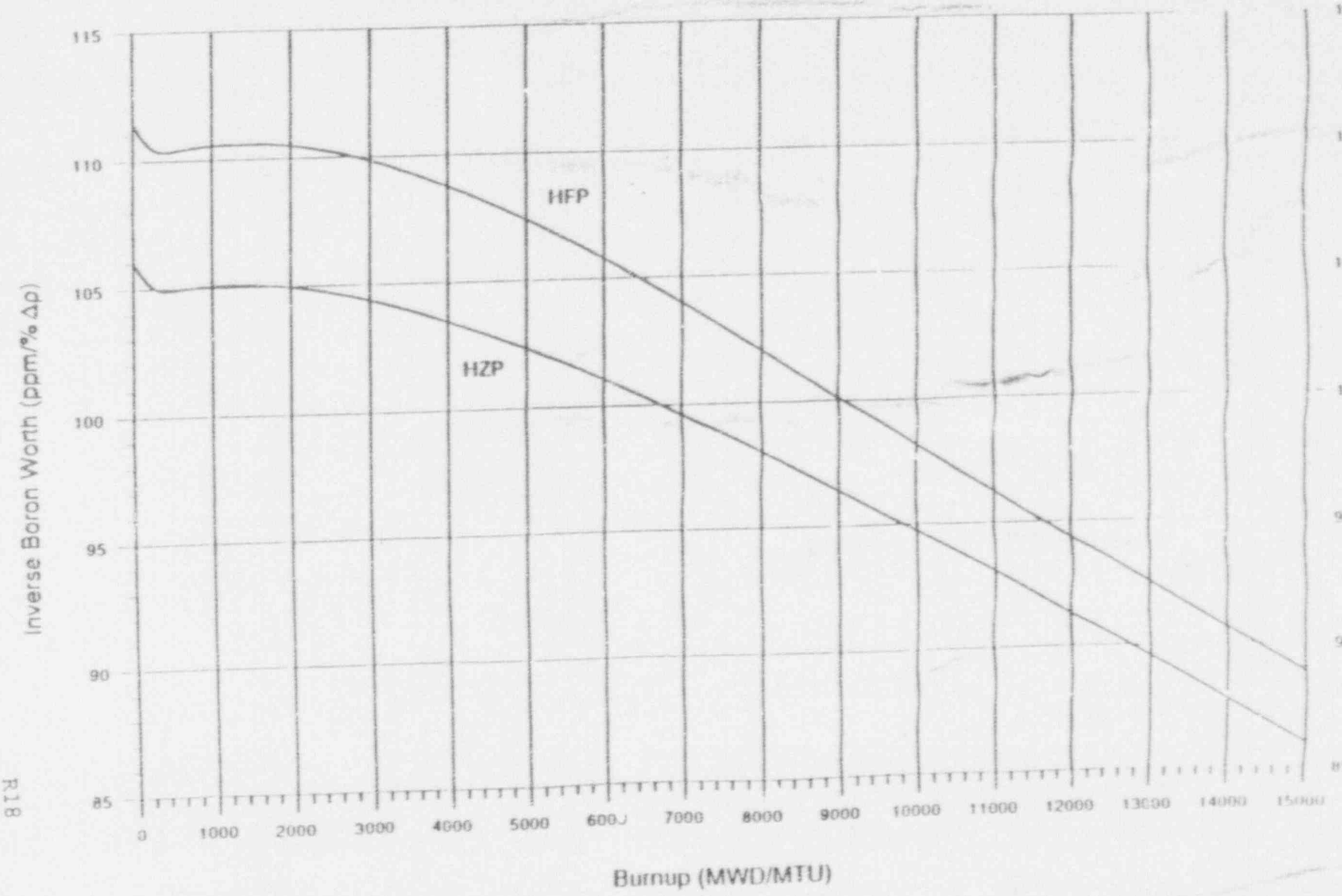

Figure II.B.1.a

Table 1
FORT CALHOUN STATION CYCLE 14
CEA GROUP WORTHS AT HZP IN %Δρ
WHEN INSERTED SEQUENTIALLY

	0 $^{MWD}/_{MTU}$	7.000 $^{MWD}/_{MTU}$	15.000 $^{MWD}/_{MTU}$
Group 4	0.61	0.52	0.57
Group 3	0.66	0.91	0.82
Group 2	1.14	1.06	1.33
Group 1	0.88	1.07	1.08
Group A	2.31	2.69	3.14
Group B	2.32	2.24	2.35
Group N	1.10	1.20	1.41
Total Worth without Group N *	7.91	8.48	9.31
Total Worth with Group N *	9.01	9.68	10.72

* Rod Totals do not equal the sum of individual banks due to roundoff.

Figure II.B.1.b

Table 2
FORT CALHOUN STATION CYCLE 14
REDUCTION IN SHUTDOWN MARGIN OR STUCK CEA(s) WORTH

CEA Conditions*	Stuck CEA(s) Worth on Reduction in Total CEA Worth at HZP	
	0 $^{MWD}/_{MTU}$ (%Δρ)	15,000 $^{MWD}/_{MTU}$ (%Δρ)
ARO, No Known Inoperable	1.22	1.55
Group 4 In, No Known Inoperable	1.22	1.55
Groups 4+3 In, No Known Inoperable	1.22	1.55
ARO, Group 4 – CEA 1 Known Inoperable	1.80	2.17
ARO, Group 4 – CEA 38 Known Inoperable	2.00	2.61
ARO, Group 4 – CEA 39 Known Inoperable	2.00	2.61
ARO, Group 4 – CEA 40 Known Inoperable	2.00	2.61
ARO, Group 4 – CEA 41 Known Inoperable	2.00	2.61
ARO, Group 3 – CEA 2 Known Inoperable	2.02	2.70
ARO, Group 3 – CEA 3 Known Inoperable	2.08	2.78
ARO, Group 3 – CEA 4 Known Inoperable	2.02	2.70
ARO, Group 3 – CEA 5 Known Inoperable	2.08	2.78
ARO, Group 2 – CEA 22 Known Inoperable	2.30	3.42
ARO, Group 2 – CEA 23 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 24 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 25 Known Inoperable	2.30	3.42
ARO, Group 2 – CEA 26 Known Inoperable	2.30	3.42
ARO, Group 2 – CEA 27 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 28 Known Inoperable	2.16	2.78
ARO, Group 2 – CEA 29 Known Inoperable	2.30	3.42
ARO, Group 1 – CEA 6 Known Inoperable	2.05	2.70
ARO, Group 1 – CEA 8 Known Inoperable	2.08	2.78
ARO, Group 1 – CEA 10 Known Inoperable	2.05	2.70
ARO, Group 1 – CEA 12 Known Inoperable	2.08	2.78
ARO, Group B – CEA 14 Known Inoperable	3.15	3.95
ARO, Group B – CEA 15 Known Inoperable	3.15	3.95
ARO, Group B – CEA 16 Known Inoperable	3.15	3.95
ARO, Group B – CEA 17 Known Inoperable	3.15	3.95
ARO, Group A – CEA 30 Known Inoperable	3.15	3.95
ARO, Group A – CEA 31 Known Inoperable	2.15	2.67
ARO, Group A – CEA 32 Known Inoperable	2.15	2.67
ARO, Group A – CEA 33 Known Inoperable	3.15	3.95
ARO, Group A – CEA 34 Known Inoperable	3.15	3.95
ARO, Group A – CEA 35 Known Inoperable	2.15	2.67
ARO, Group A – CEA 36 Known Inoperable	2.15	2.67
ARO, Group A – CEA 37 Known Inoperable	3.15	3.95

* Inoperable CEA is assumed to be "stuck out". All groups not specifically inserted are assumed to be 100% withdrawn

Figure II.B.2.a

Cycle 14 Sequential Rod Worth vs. Rod Position at 0 MWD/MTU

Groups 1-4

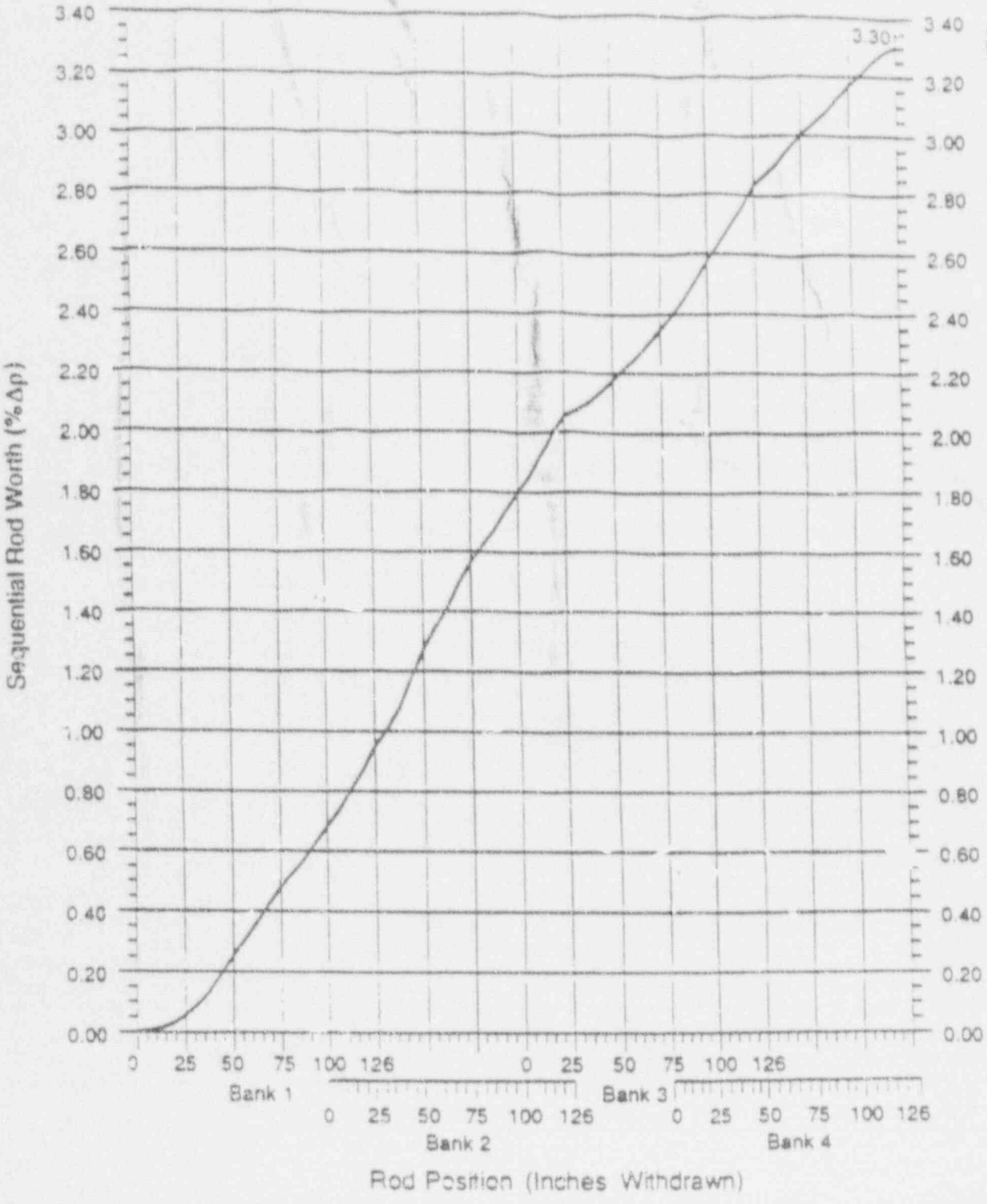

Figure II.B.2.b

Cycle 14 Sequential Rod Worth vs. Rod Position at 7,000 MWD/MTU

Groups 1-4

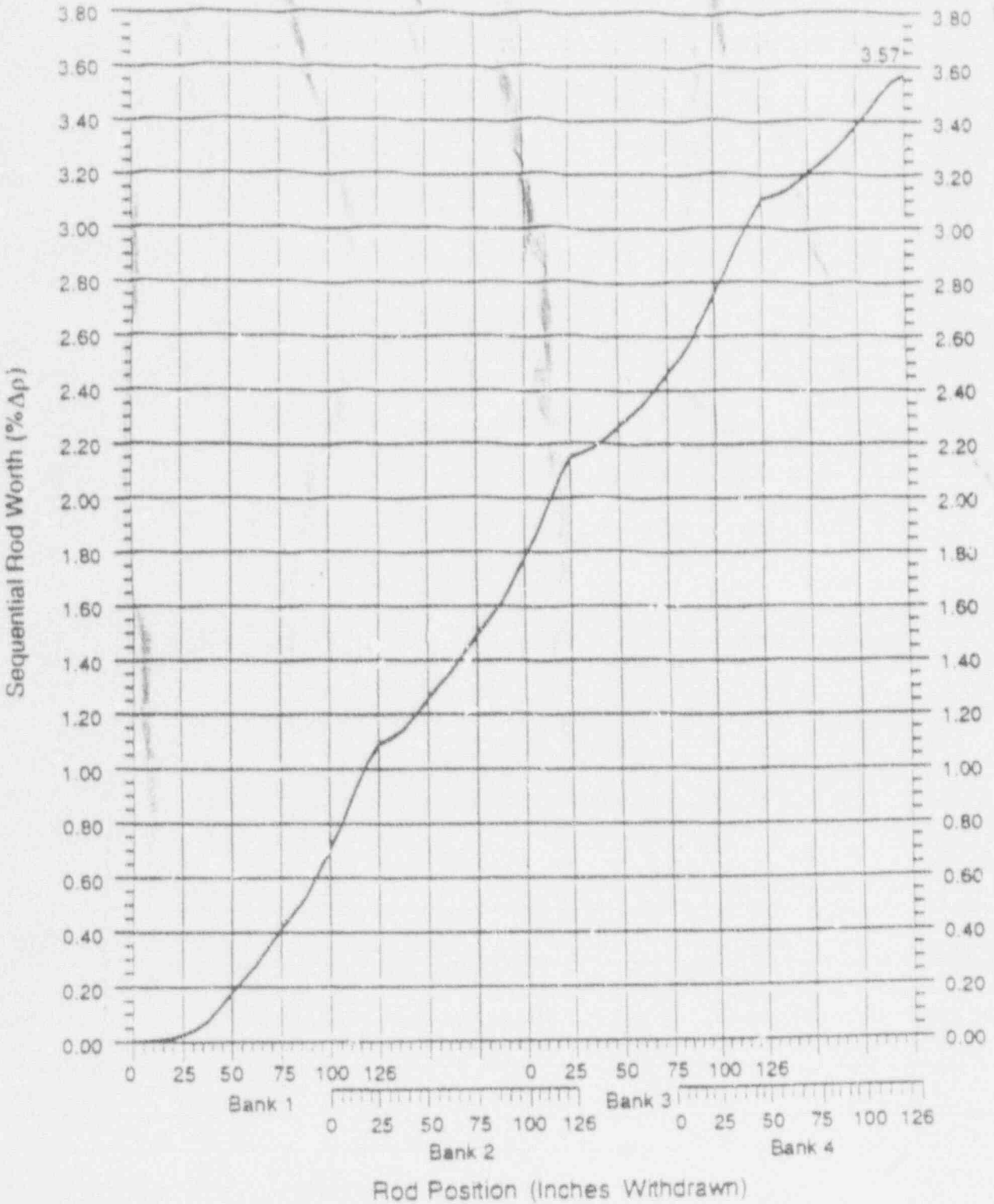

Figure II.B.2.c

Cycle 14 Sequential Rod Worth vs. Rod Position at 15,000 MWD/MTU

Groups 1-4

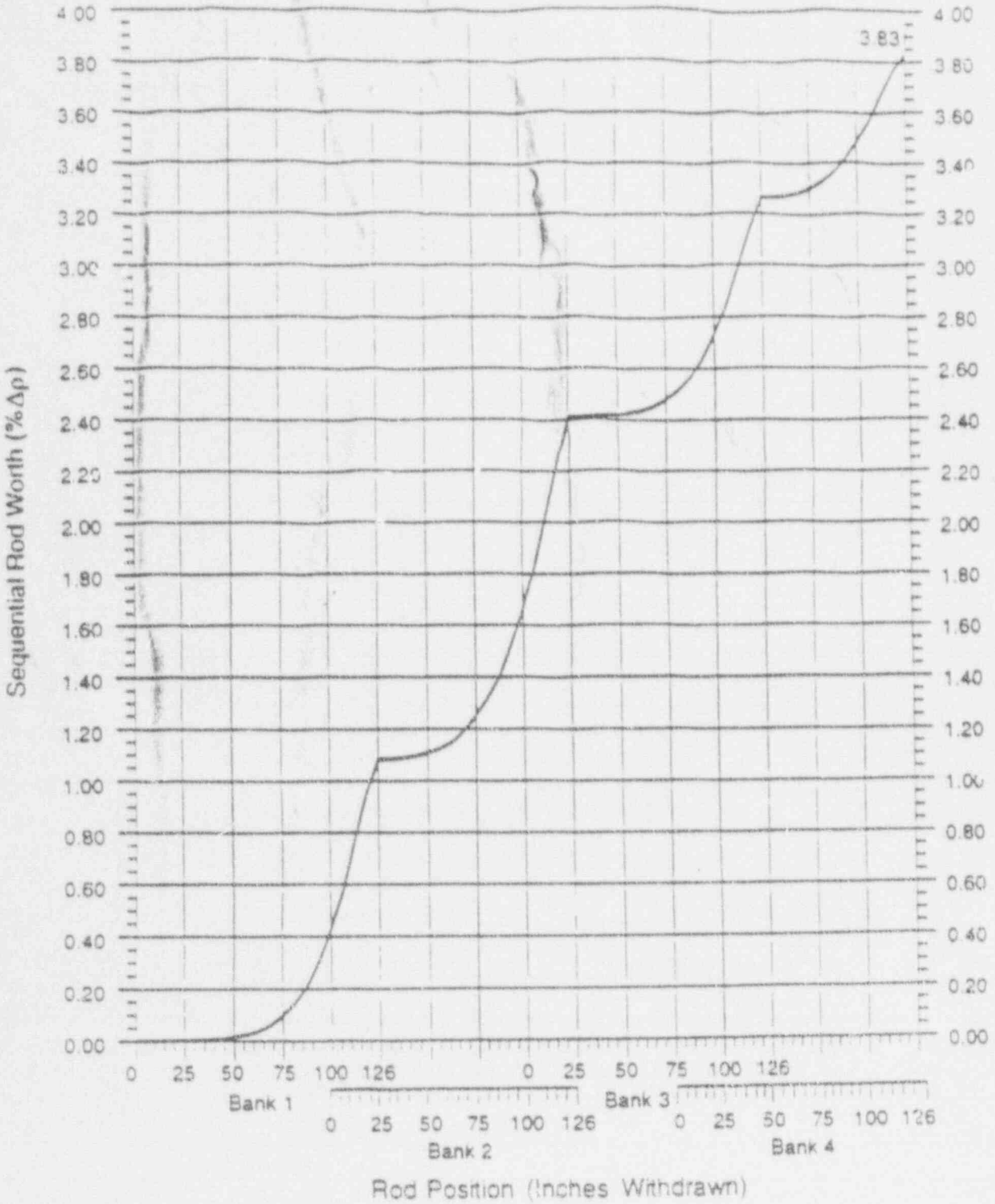

Figure II.B.3.a

Cycle 14 Group 4 Integral Rod Worth

(HZP, 0 MWD/MTU)

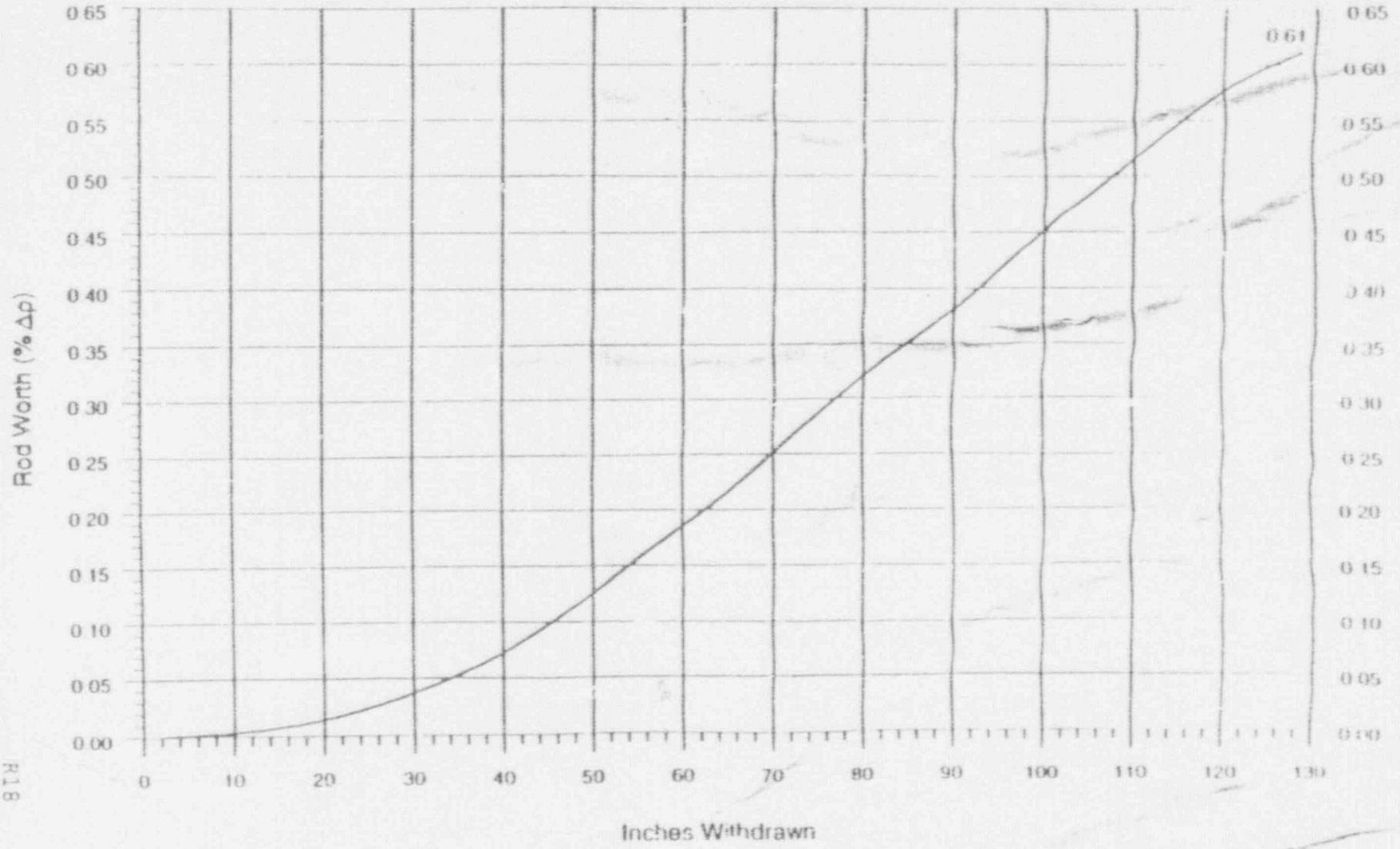

Figure II.B.3.b

Cycle 14 Group 4 Integral Rod Worth

(HZP, 7,000 MWD/MTU)

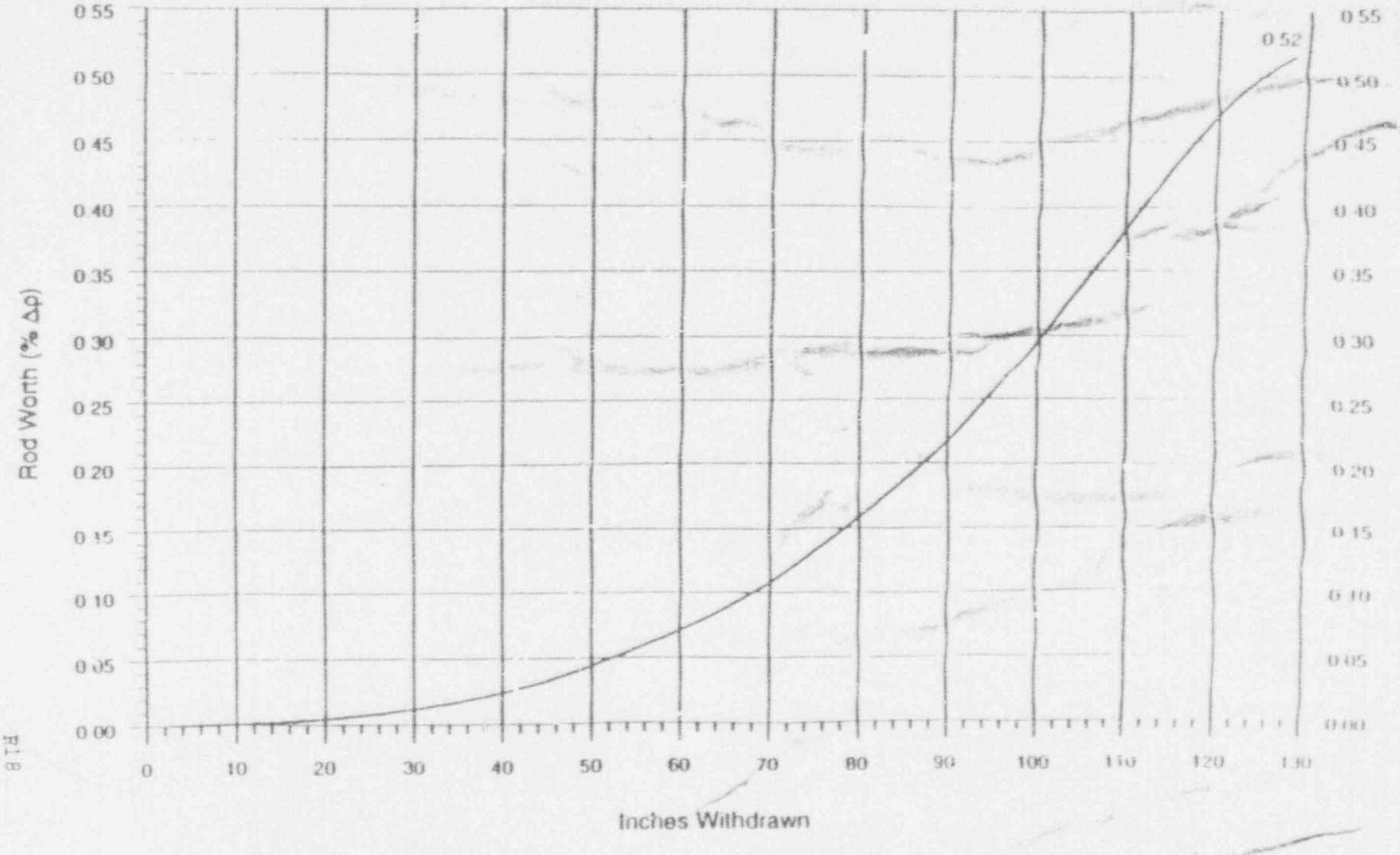

Figure II.B.3.c

Cycle 14 Group 4 Integral Rod Worth

(HZP, 15,000 MWD/MTU)

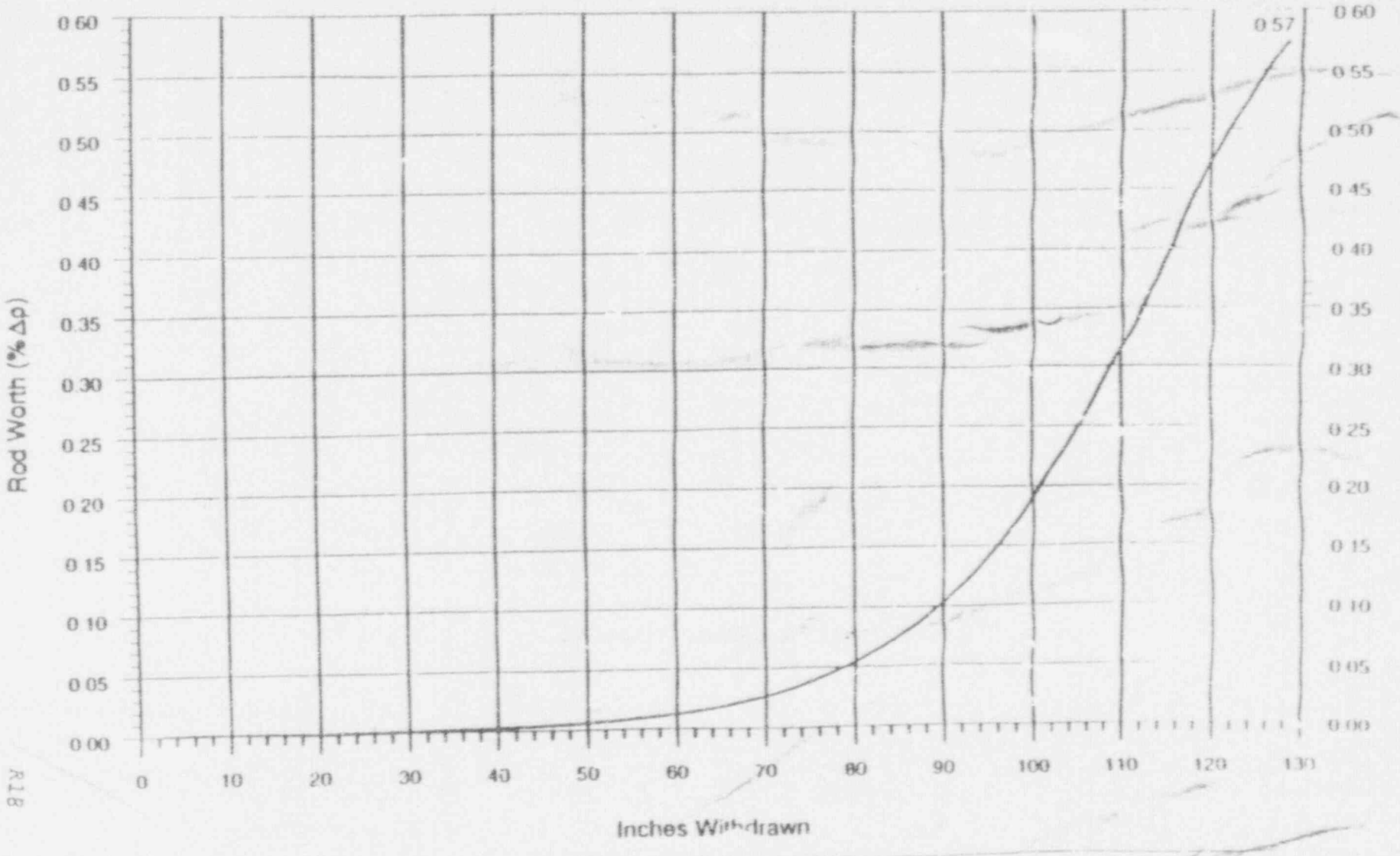

Figure II.C.1

Cycle 14 Excess Reactivity vs Burnup

(ARO, Hot Full Power, Equilibrium Xenon)

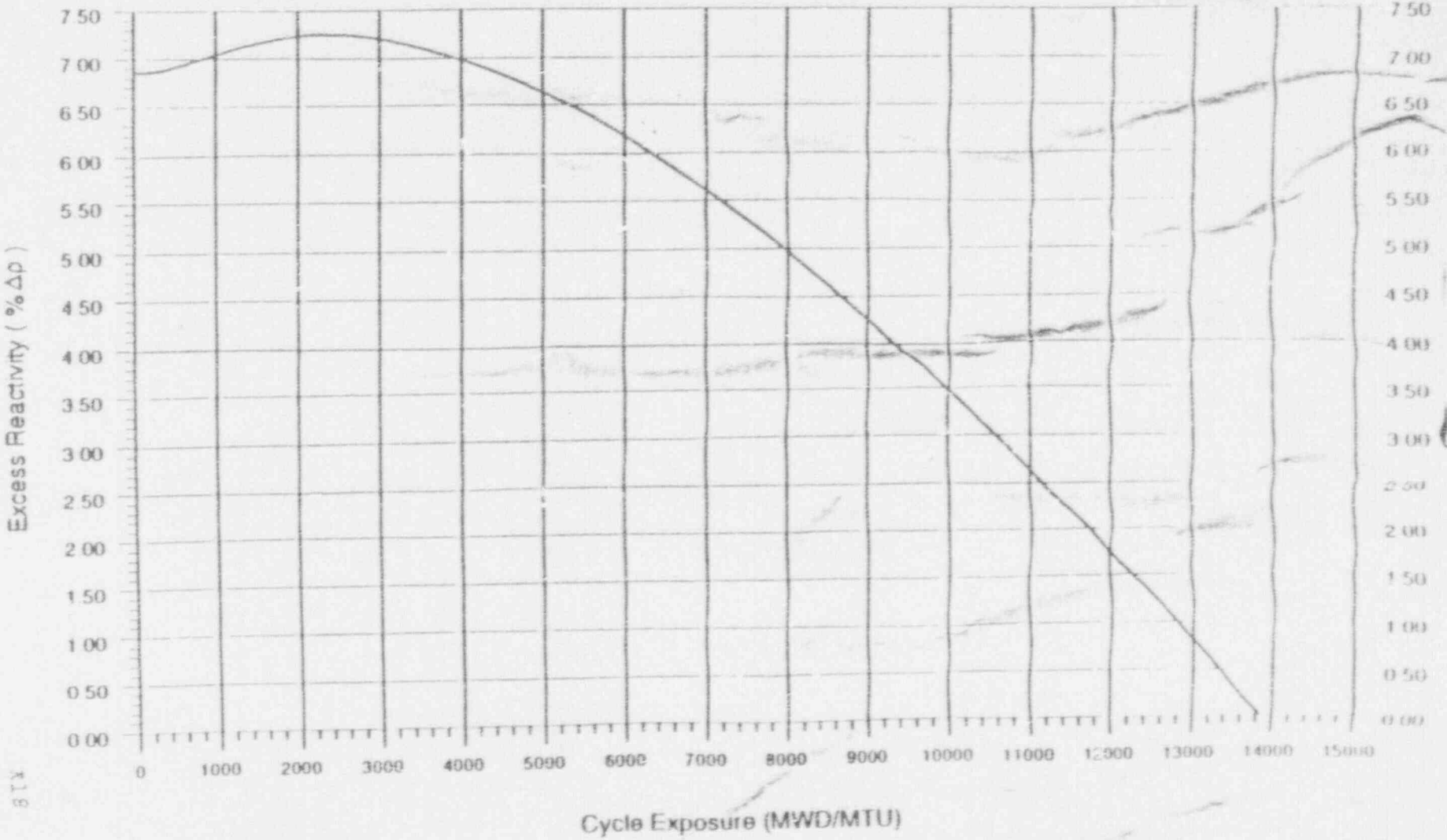

Figure II.C.2.a

Cycle 14 Total Power Defect vs Power
(0 to 6,000 MWD/MTU)

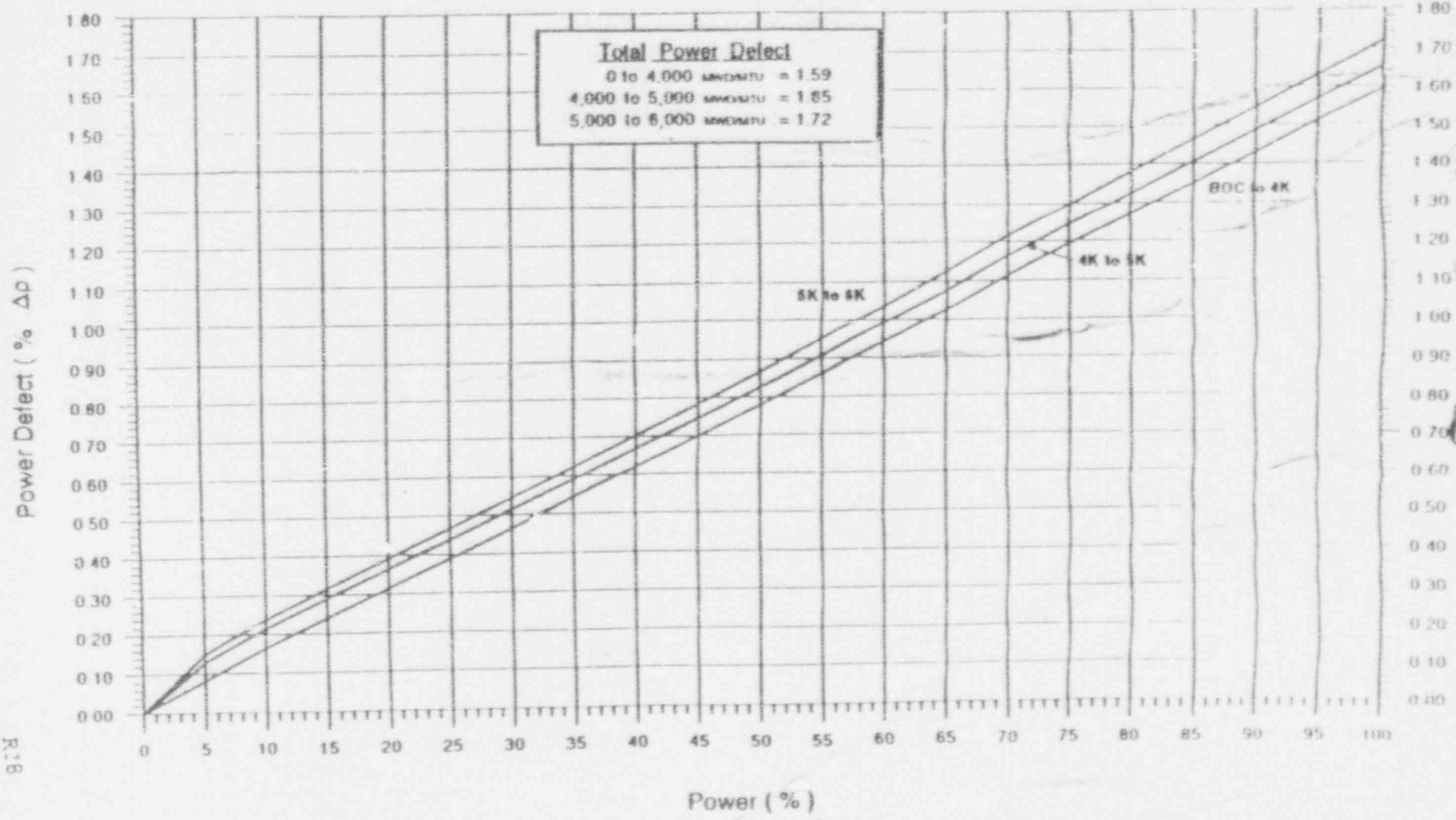

Figure II.C.2.b

Cycle 14 Total Power Defect vs Power

(6,000 to 11,000 MWD/MTU)

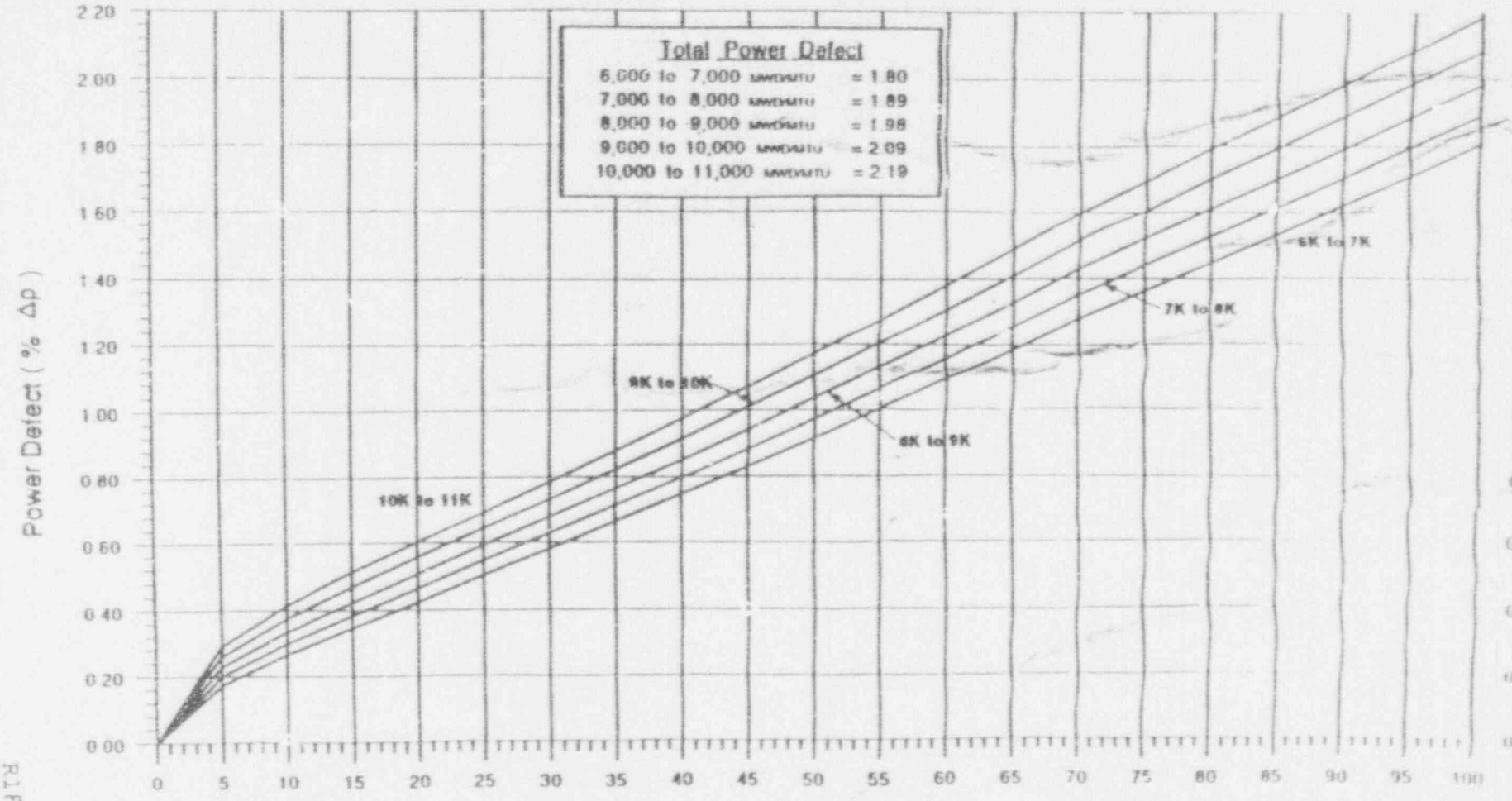

Figure II.C.2.c

Cycle 14 Total Power Defect vs Power

(11,000 to 15,000 MWD/MTU)

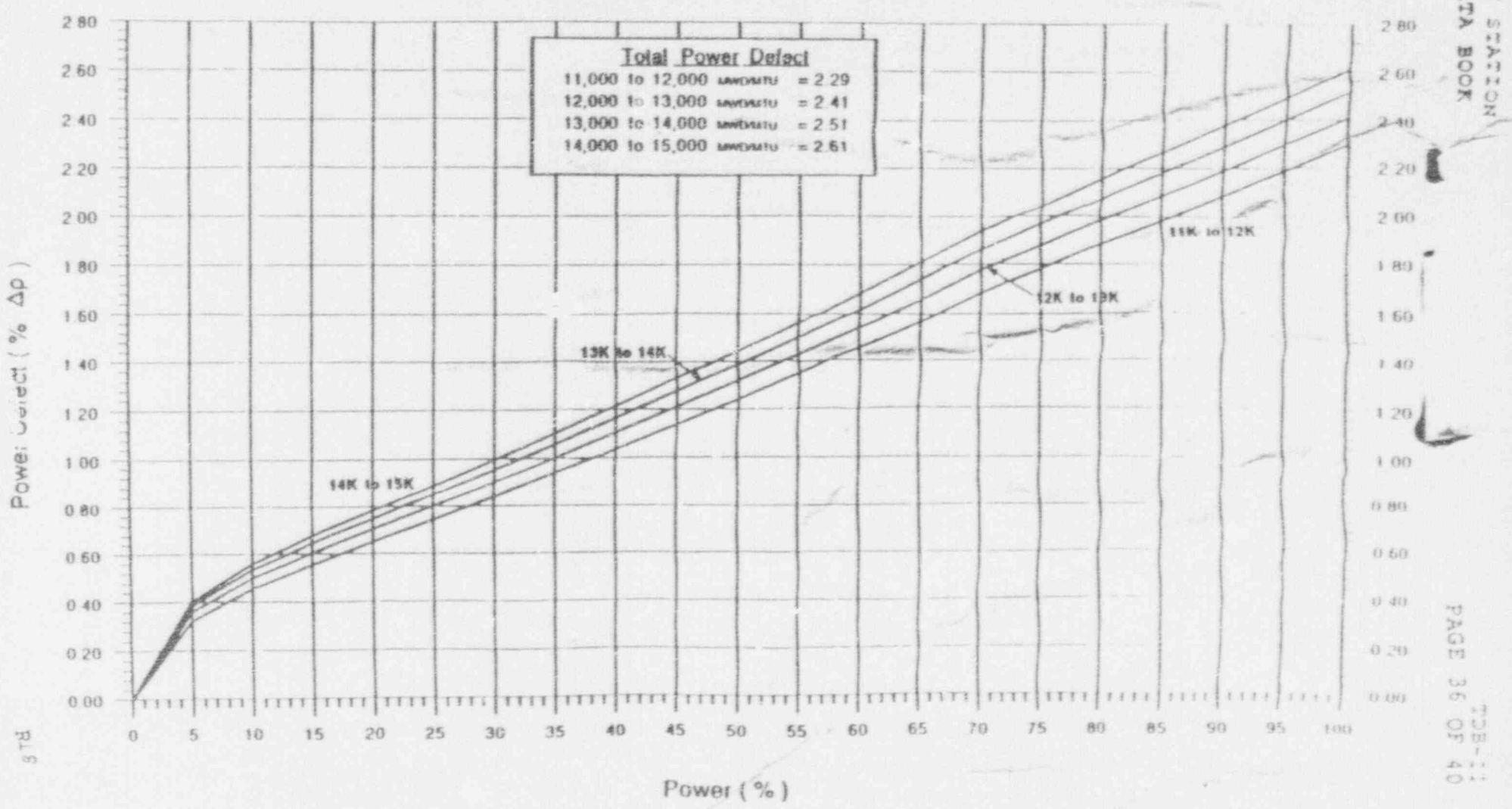

Figure II.C.3

Cycle 14 Moderator Temperature Coefficient vs Burnup

(ARO, HFP, Equilibrium Xenon)

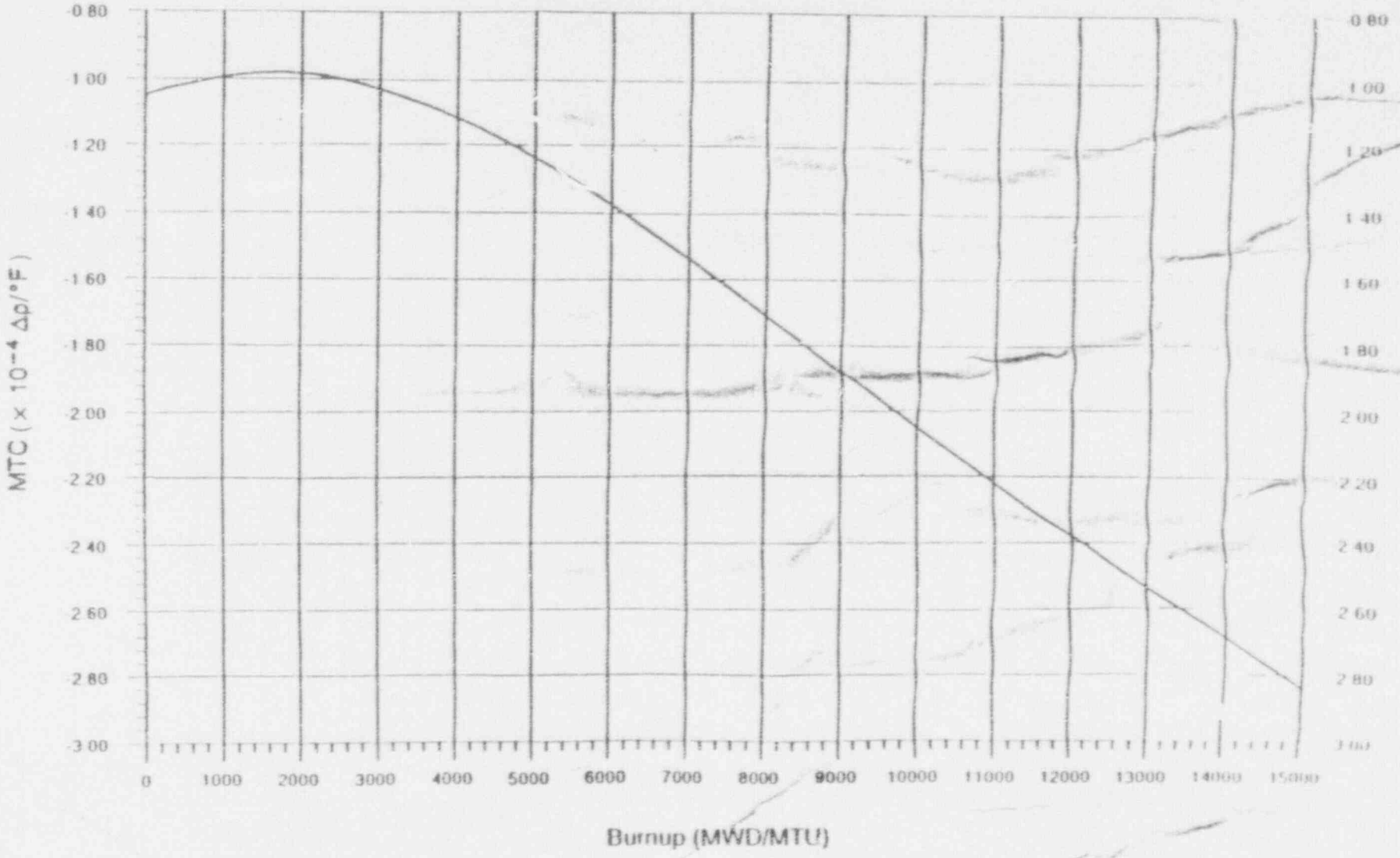

Figure II.D.1.a

Cycle 14 Equilibrium Xenon Reactivity vs Percent Power

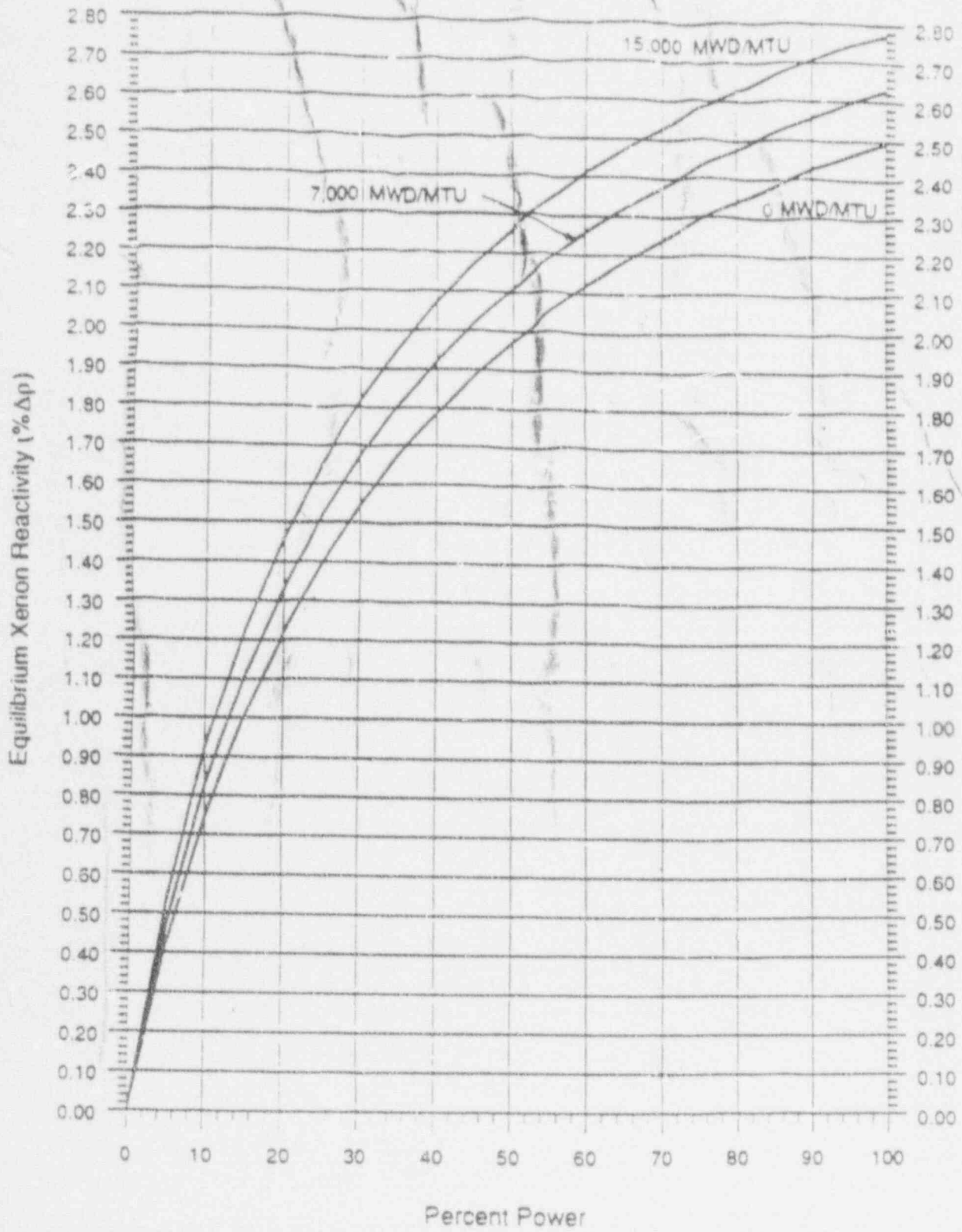

Figure II.D.1.b

Cycle 14 Xenon Reactivity Worth vs Burnup

(All Rods Out, HFP)

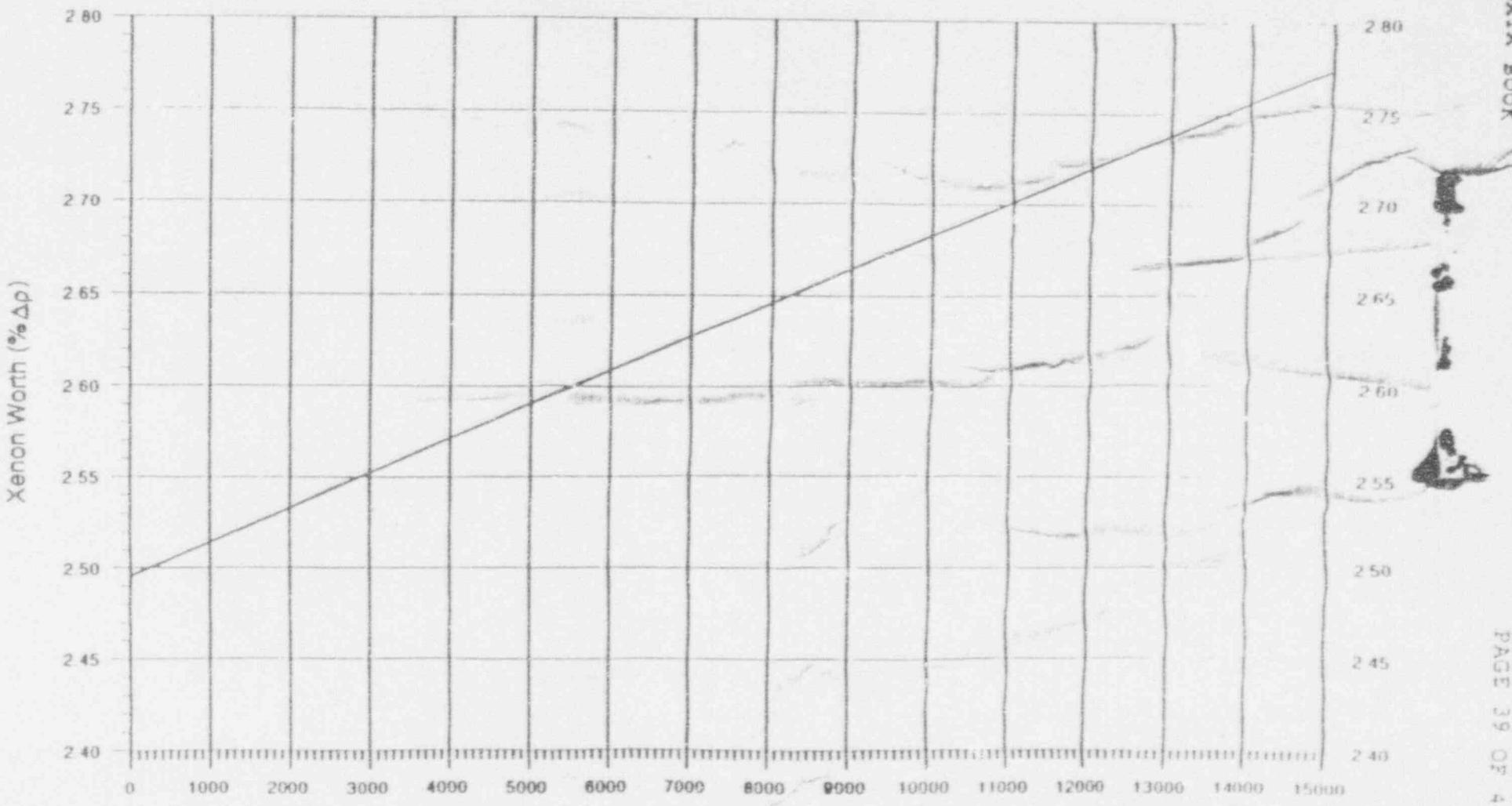

Figure II.D.2

Cycle 14 Xenon Worth After Trip

(7000 MWD/MTU)