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SANDRA E. FOLSOM
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JUDITH A. SANDLER
EDWARD D. YOUNG, III



November 6, 1981



Administrative Judge
Gary L. Milhollin
Atomic Safety & Licensing Board
1815 Jefferson Street
Madison, Wisconsin 53711

In the Matter of
Metropolitan Edison Company
(Three Mile Island Nuclear Station, Unit No. 1)
Docket No. 50-289 SP (Restart)

Dear Judge Milhollin:

I enclose several documents which are being provided for the following reasons:

1. A chart which describes by participants and dates the various NRC and Licensee examinations administered to TMI-1 operators, which have been the subject of discovery and which will be discussed during the reopened hearing. You requested that Licensee develop this chart as an aid to the participants during the hearing when reference to particular exams is necessary.

2. Affidavits in support of Licensee's responses to discovery requests. With the press of providing timely responses to discovery requests, Licensee did not complete and coincidentally provide affidavits in support of its interrogatory responses. Affidavits which we indicated with our discovery responses would subsequently be provided, are enclosed.

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3. Kelly-administered examination of Mr. V. In our earlier discovery responses, we indicated that one examination from the Kelly-administered exams in April, 1980, had not been located. The missing examination has been found and is enclosed.

This also will confirm that in response to a request from the Aamodts, Licensee is distributing today under separate cover (directly from the TMI site) some twenty completed RWP examinations radomly selected from the period April 15 to May 15 (but excluding April 28), 1979.

Sincerely,

Ernest L. Blake, Jr.

Ernest L. Blake, Jr.
Counsel for Licensee

cc: (w/encl.) Reopened Hearing Discovery Service List (attached)
(w/out encl.) TMI-1 Restart Service List (attached)

(Reopened Hearing Discovery Service List)

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Special Master

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 SP |
| | ) | |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | (Restart) |

SERVICE LIST

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Special Master

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| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 SP |
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| (Three Mile Island Nuclear Station, Unit No. 1) | ) | (Restart) |

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SUMMARY OF PRIMARY TMI-1 OPERATOR EXAMINATIONS
GIVEN SINCE MARCH 28, 1979

| EXAM | DATE | LOCATION | EXAMINATION ADMINISTRATOR | PURPOSE | SUBJECT MATTER | METHOD OF ADMINISTRATION | PARTICI-PANTS |
|---|---|---|---|---|---|---|---|
| KELLY | RO-4/2-4/4/80 | South-Auditorium of TMI-I Service Building | PQS Corp. | OARP Comprehensive Exams; served as 1979-80 Requalification Exams (originally intended as NRC mock exam) | RO Categories A,A',B,C,D,E,F, G, T (as noted on cover sheet of exam) | Classroom Closed book | RO-A through HH inclusive |
| | SRO-4/3 and 4/4/80 | South Auditorium of TMI-Service Building | | | SRO Categories H,I,J,K,L (as noted on cover sheet of exam) | | SRO-A,B,E, I,J,O,P, W,X,BB,CC, EE,FF,GG |
| Round 1, Non-Cat T Make-Up (Cycle 7-3) | 7-8/80 | TMI Classroom 2 of Training Complex | Licensee | Parts of these requal. cycle exams were used as non-cat T make-up exams for those who had received less than 80% on non Cat T areas in the Kelly exams | Unit I Requal. Training | Classroom Closed book | Wk.#1-C,D,B<br>Wk.#2-E,F,G,UU<br>Wk.#3-I,J,EE, M,HH,WW<br>Wk.#4-O,P,Q,R<br>Wk.#5-W,X,Y,AA, BB,CC<br>Wk.#6-S,T,U,V, GG |
| Round 2, Non-Cat T Make-up (Cycle 7-4) | 8-9/80 | TMI Classroom 2 of Training Complex | Licensee | Parts of these requal. cycle exams were used as non-cat T make-up exams for those who had received less than 80% on non Cat T areas in the Kelly exams | Unit I Requal. Training | Classroom Closed book | Wk.#2-E,F,H<br>Wk.#3-I,J,L,M,HH<br>Wk.#4-O,P,Q,R,OO XX<br>Wk.#5-S,T,U<br>Wk.#6-V,W,X,Y,Z, AA,SS |

| EXAM | DATE | LOCATION | EXAMINATION ADMINISTRATOR | PURPOSE | SUBJECT MATTER | METHOD OF ADMINISTRATION | PARTICI-PANTS |
|---|---|---|---|---|---|---|---|
| Round 3, Non-Cat T Make-up (Cycle 7-5) | 9-10/80 | TMI Classroom 2 of Training Complex | Licensee | Parts of these requal. cycle exams were used as non-Cat T make-up exams for those who had received less than 80% on non Cat T areas in the Kelly exams | Unit I Requal. Training | Classroom Closed book | Wk.#1-A,B,C,D,Z, PP,TT*,EEE* Wk.#2-E,F,G,H, FFF*,GGG*,UU*,QQ* Wk.#3-I,J,L,HH, MM,WW Wk.#4-O,Q,R,JJ, KK,RR,YY,XX,HHH* Wk.#5-S,T,U,GG Wk.#6-V,W,X,Y,III<br><br>*answered only 1 question |
| Round 1, Cat. T Make-Up (Cycle 7-6) | 11/21/80<br>11/26/80<br>12/5/80<br>12/12/80<br>12/19/80 | TMI Classroom 2 of Training Complex | Licensee | Appropriate parts of this requal. cycle exam were used as a Cat. T make-up exam for those who either had not taken the Kelly Exam or had received less than 90% on Cat. T | Category T | Classroom Closed book | 11/21-LL,D,C,B, Z,A,PP,TT 11/26-G,F,H,E, KK,QQ 12/5-J,L,HH,II, NN,I 12/12-OO,R,JJ, RR,P,Q,O 12/19-GG,W,MM,X, S,Y |
| Round 4, Non-Cat T Make-Up (Cycle 7-6) | 2-3/81 | TMI Classroom 2 of Training Complex | Licensee | During Review Program, Non-Cat T make up exams given for those who had received less than 80% in Non-Cat T areas on the Kelly exams or on previous Non-Cat T Kelly make ups | Unit 1 Requal. Training | Classroom Closed book | B,C,F,G,H,I,P, S,U,W,Y,Z,BB, CC,GG,R |

| EXAM | DATE | LOCATION | EXAMINATION ADMINISTRATOR | PURPOSE | SUBJECT MATTER | METHOD OF ADMINISTRATION | PARTICI-PANTS |
|---|---|---|---|---|---|---|---|
| Round 2, Cat. T Make-up (Cycle 7-6) | 3-4/81 | Unknown | Licensee | Cat. T. Make Up Exam for those who either had not taken the Cat. T exam or had taken it and received less than 90% | Category T | Take Home Closed book | EE,SS,UU,OO, H,FF,G |
| ATTS | RO-4/1 and 4/2/81 SRO-4/2 & 4/3/81 | TMI Classrooms 1 & 7 of Training Complex | ATTS, Inc. | NRC Mock Exams | RO Categories A,B,C,D,E,F,G,H (as noted on sheet of exam) | Classroom Closed book | RO-4/1-X,EE, B,FF,E,F,GG, BB,U,Z,C,D, UU,L,HH,NN, Q,QQ,RR,I<br>4/2-A,OO,R,W, O,P,SS,AA,G, H,Y,V,S,CC, DD,T |
| | | | | | SRO Categories I,J,K,L,M,N, (as noted on cover sheet of exam) | | SRO-4/2-GG,F, E,Z,BB,FF,B, RR<br>4/3-U,O,P,W, EE,X,A,CC,S, DD,QQ,I |
| NRC | RO-4/21 and 4/23/81 SRO-4/22 and 4/24/81 | TMI Classrooms 1 and 7 of Training Complex | NRC | Operator License Exams | Comprehensive | Classroom Closed book | RO-4/21-V,T,CC, GG,BB,U,UU,SS, H,G,D,F,EE,FF, X,E,RR,QQ,B<br>4-23-L,Y,P,DD, NN,AA,C,HH,Q, O,I,A,W,S,Z, R,OO |
| | | | | | | | SRO-4/22-CC,GG, BB,U,F,EE,FF,X, E,RR,QQ,B<br>4/24-P,DD,O,I, A,W,S,Z |

| EXAM | DATE | LOCATION | EXAMINATION ADMINISTRATOR | PURPOSE | SUBJECT MATTER | METHOD OF ADMINISTRATION | PARTICI-PANTS |
|---|---|---|---|---|---|---|---|
| Round 3, Cat. T Make-Up | 6/25/81 | TMI Classroom 5 of Training Complex | Licensee | Cat. T Make-Up exam for those who had received less than 90% on previous Cat. T exams | Category T | Classroom Closed book | G,H,FF,OO |
| NRC | RO-10/21 and 10/22/81 SRO-10/28 and 10/29 | TMI Classrooms 118 and 119 Training Bldg. | NRC | Operator License Exams | Comprehensive | Classroom Closed book | RO-10/21-B, CC,E,S,BB, EE,GG,FF,T, D,KK,A,WW, AA,H,G,C 10/22-U,P, R,RR,F,OO,V, UU,DD,Q,QC, L,I,Y,Z<br>SRO-10/28-E, CC,E,S,RR,BB, FF,WW,I,Z,F 10/29-B,P,U, GG,DD,QQ,A, KK |

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | (Restart) |

AFFIDAVIT OF DR. ROBERT L. LONG

DR. ROBERT L. LONG, being duly sworn according to law, deposes and says that he is Director of GPU Nuclear's Training and Education Department; that the information contained in Licensee's Response to Aamondt's Second Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (as Modified by Agreement) to Request 12 is true and correct to the best of his knowledge, information and belief.

Robert L. Long

Dr. Robert L. Long

Sworn to and subscribed before
me this 5th day of November,
1981

Alice J. House

Notary Public

ALICE J. HOUSE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires March 7, 1985

My commission expires

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | (Restart) |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |
| | ) | |

AFFIDAVIT OF MICHAEL J. ROSS

MICHAEL J. ROSS, being duly sworn according to law, deposes and says that he is Manager of Plant Operations, TMI-1; that the information contained in Licensee's Response to Aamondt's Second Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (as Modified by Agreement) to Request No. 4 is true and correct to the best of his knowledge, information and belief.

Michael J. Ross

Michael J. Ross

Sworn to and subscribed before
me this 5th day of
November, 1981

Darla Jean Berry
Notary Public

My Commission Expires June 17, 1985

DARLA JEAN BERRY, NOTARY PUBLIC
MIDDLETOWN BORO, DAUPHIN COUNTY
MY COMMISSION EXPIRES JUNE 17, 1985
Member, Pennsylvania Association of Notaries

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SFAETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

## AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is a senior Vice President of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamodt's Follow-On Interrogatories of LIcensee Re Reopened Hearings of Cheating Incident to Requests3, 13 and 17 b and c is true and correct to the best of his knowledge.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed before me
this 5th day of November, 1981

Cathy L. Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa
My Commission Expires Oct. 24 1983

My Commission Expires

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD.

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | (Restart) |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is Senior Vice President of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamodt's First Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (As Modified by Agreement and by Rulings of the Special Master) to Issue 1, Request No. 1, and Issue 2, Request Nos. 1 and 2, is true and correct to the best of his knowledge, information and belief.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed
before me this 5th day
of November 1981.

Cathy L. Drey
Notary Public

CATHY L. DREY, Notary Public
[illegible] Township, Dauphin County, Pa.
My Commission Expires Oct. 21, 19[illegible]

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | |
| | ) | Docket No. 50-289 |
| | ) | (Restart) |
| (Three Mile Island Nuclear | ) | |
| Station, Unit No. I) | ) | |
| | ) | |

AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is Senior Vice President of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamondt's Second Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (as Modified by Agreement) to Requests Nos. 1, 6 and 7 is true and correct to the best of his knowledge, information and belief.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed before me this 5th day of November, 1981

Cathy L. Brey

Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | (Restart) |

AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is a Senior Vice President of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamodt's Third Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident to Request 5 is true and correct to the best of his knowledge, information and belief.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed
before me this 5th day
of November, 1981

Cathy A. Brey

Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | (Restart) |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is a Senior Vice President of Metropolitan Edison Company; that the information contained in Licensee's Supplemental Response to Aamodt's First Set of Discovery Requests of Licensee In Reopened Hearing of Cheating Incident (As Modified by Agreement and by by Rulings of the Special Master) to Issue No. 2, Request No. 1, is true and correct to the best of his knowledge, information, and belief.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed
before me this 5th day
of November, 1981

Cathy L. Brey

Notary Public

CATHY L. BREY, Notary Public
Lower Paxton Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear | ) | (Restart) |
| Station, Unit No. 1 | ) | |

AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is a Senior Vice President of Metropolitan Edison Company; that the information contained in Licensee's Response to TMIA's First Set of Interrogatories Addressed to Licensee (As Modified by Agreement) to Requests 1, 2, 3, 4, 9, 10, 11, 12, 40, 46, 47, 48, 49, 50, and 51 is true and correct to the best of his knowledge, information and belief.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed
before me this 5th day
of November , 1981

Cathy L. Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear Station, Unit NO. 1) | ) | |

AFFIDAVIT OF ROBERT C. ARNOLD

ROBERT C. ARNOLD, being duly sworn according to law, deposes and says that he is a senior Vice President of the Metropolitan Edison Company; that the information contained in Licensee's Response to Aamodt's Additional Interrogatories to NRC Staff and Licensee in Reopened Hearing of Cheating Incident (As Modified by Agreement and Rulings of the Special Master) to Request No. 5 is true and correct to the best of his knowledge.

Robert C. Arnold

Robert C. Arnold

Sworn to and subscribed before me
this 5th day of November, 1981

Cathy L Brey

Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires_____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docker No. 50-289 |
| | ) | |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

AFFIDAVIT OF J.F. WILSON

J.F. WILSON, being duly sworn according to law, deposes and says that he is an attorney; that the information contained in Licensee's Response to TMIA's First Set of Interrogatories Addressed to Licensee (As Modified by Agreement) to Requests 5, 6, 8, 18, 20, 24, 25, 27f, 42, 43, 44, 52 and 53 is true and correct to the best of his knowledge, information and belief.

J.F. Wilson

Sworn to and subscribed
before me this 4th day
of November, 1981

Cathy L. Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Jan. 29, 1985

My Commission Expires on _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

AFFIDAVIT OF J.F. WILSON

J.F. WILSON, being duly sworn according to law, deposes and says that he is an attorney; that the information contained in Licensee's Response to Aamodt's Follow-On Interrogatories of Licensee Re Reopened Hearings of Cheating Incident to Requests 2, 6, 10, 11 and 12 is true and correct to the best of his knowledge.

J.F. WILSON

Sworn to and subscribed before me
this 4th day of November, 1981

Cathy L. Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa
My Commission Expires Oct. 24, 1982

My Commission Expires

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

AFFIDAVIT OF R.D. LLOYD

R.D. LLOYD, being duly sworn according to law, deposes and says that he is an attorney; that the information contained in Licensee's Response to Aamodt's Follow-On Interrogatories of Licensee Re Reopened Hearings of Cheating Incident to Requests No. 7, 9 re telephone conversation of 9/22/81, and re grader's credentials and modified questions, and 15 re ATT's view on proctors is true and correct to the best of his knowledge.

R.D. Lloyd

R.D. Lloyd

Sworn to and subscribed before me
this 4th day of November, 1981

Cathy L. Drey
Notary Public

CATHY L. DREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| | ) | (Restart) |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | |

AFFIDAVIT OF NELSON D. BROWN

NELSON D. BROWN, being duly sworn according to law, deposes and says that he is Supervisor, Licensed Operator Training, TMI Unit I of Metropolitan Edison Company; that the informantion contained in Licensee's Suplemental Response to Aamodt's First Set of Discovery Requests of Licensee In Reopened Hearing of Cheating Incident (As Modified by Agreement and by Rulings of the Special Master) to Issue No. 5 is true and correct to the best of his knowledge, information and belief.

Nelson D. Brown

Sworn to and subscribed
before me this 4th day
of November, 1981

Cathy L Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | Docket No. 50-289 |
| | ) | (Restart) |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | |

AFFIDAVIT OF NELSON D. BROWN

NELSON D. BROWN, being duly sworn according to law, deposes and says that he is Supervisor, Licensed Operator Training, TMI-1; that the information contained in Licensee's Response to Aamodt's Follow-On Interrogatories Of Licensee Re Reopened Hearings of Cheating Incident to Request No. 8, and to Request No. 15 except ATT's view is true and correct to the best of his knowledge, information and belief.

Nelson D. Brown

Nelson D. Brown

Sworn to and subscribed before
me this 4th day of
November 1981

Cathy L. Brey
Notary Public

My Commission Expires

Cathy L. Brey, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 (Restart) |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | |

AFFIDAVIT OF NELSON D. BROWN

NELSON D. BROWN, being duly sworn according to law, deposes and says that he is Supervisor, Licensed Operator Training, TMI Unit I of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamodt's First Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (As Modified by Agreement and by Rulings of the Special Master) to Issue 5, Requests Nos. 1, 3 and 5, is true and correct to the best of his knowledge, information and belief.

Nelson D. Brown

Sworn to and subscribed
before me this 4th day
of November 1981.

Cathy L. Brey
Notary Public

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | (Restart) |

AFFIDAVIT OF SAMUEL L. NEWTON

SAMUEL L. NEWTON, being duly sworn according to law, deposes and says that he is Operator Training Manager, TMI - Unit I of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamondt's Second Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (as Modified by Agreement) to Requests Nos. 5 and 8 are true and correct to the best of his knowledge, information and belief.

Samuel L. Newton

Sworn to and subscribed
before me this 4th day
of November, 1981

Cathy L. Brey
Notary Public

CATHY L. GREY, Notary Public
Londonderry Twp., Dauphin County, Pa
My Commission Expires Oct. 24, 1983

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | (Restart) |

AFFIDAVIT OF SAMUEL L. NEWTON

SAMUEL L. NEWTON, being duly sworn according to law, deposes and says that he is Operator Training Manager - TMI Unit I of Metropolitan Edison Company; that the information contained in Licensee's Response to Aamodt's First Set of Discovery Requests of Licensee in Reopened Hearing of Cheating Incident (As Modified by Agreement and by Rulings of the Special Master) to Issue 12, Requests Nos. 1 and 2, are true and correct to the best of his knowledge, information and belief.

Samuel L. Newton

Sworn to and subscribed

before me this 4th day

of November, 1981

Cathy L. Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the matter of | ) | |
| METROPOLITAN EDISON COMPANY | ) | Docket No. 50-289 |
| (Three Mile Island Nuclear Station, Unit No. 1) | ) | |

AFFIDAVIT OF SAMUEL L. NEWTON

SAMUEL L. NEWTON, being duly sworn according to law, deposes and says that he is Operator Training Manager, TMI-Unit I; that the information contained in Licensee's Response to Aamodt's Follow-On Interrogatories of Licensee Re Reopened Hearings of Cheating Incident to Request 9 re Licensee Proctors is true and correct to the best of his knowledge, information and belief.

Samuel L. Newton

Sworn to and subscribed before
me this 4th day of November, 1981

Cathy L. Brey
Notary Public

My Commission Expires

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| METROPOLITAN EDISON COMPANY | ) | |
| | ) | |
| | ) | Docket No. 50-289 |
| | ) | |
| (Three Mile Island Nuclear Station, Unit No. I) | ) | |

AFFIDAVIT OF SAMUEL L. NEWTON

SAMUEL L. NEWTON, being duly sworn according to law, deposes and says that he is Operator Training Manager, TMI - Unit I; that the information contained in Licensee's Response to Aamodt's Follow-On Interrogatories of Licensee Re Reopened Hearings of Cheating Incident to Request No. 16 is true and correct to the best of his knowledge, information and belief.

Samuel L. Newton

Sworn to and subscribed before
me this 4th day of November, 1981

Cathy L. Brey
Notary Public

CATHY L. BREY, Notary Public
Londonderry Twp., Dauphin County, Pa.
My Commission Expires Oct. 24, 1983

My Commission Expires _____

PQS CORPORATION

REACTOR OPERATOR LICENSE EXAMINATION

Facility Three Mile Island #1

Reactor Type PWR - Babcock & Wilcox

Date Administered April 1980

Examiner F.L. Kelly

Applicant V

| Category Value | % of Total | Applicant's Score | % of Cat. Value | |
|---|---|---|---|---|
| 9.5 | 13.8 | [illegible] | 95.3 | A. PRINCIPLES OF REACTOR OPERATION |
| 8.0 | 11.7 | [illegible] | 97.5 | A'. PRINCIPLES OF HEAT TRANSFER AND FLUID FLOW |
| 8.5 | 12.4 | 7.41 | 87.2 | B. FEATURES OF FACILITY DESIGN |
| 8.0 | 11.7 | [illegible] | 70.0 | C. GENERAL OPERATING CHARACTERISTIC |
| 7.5 | 11.0 | 72 | 96.0 | D. INSTRUMENTS AND CONTROLS |
| 8.0 | 11.7 | 7.35 | 91.9 | E. SAFETY AND EMERGENCY SYSTEMS |
| 10.0 | 14.6 | 8.62 | 86.2 | F. STANDARD AND EMERGENCY OPERATING PROCEDURES |
| 9.0 | 13.1 | 8.0 | 88.9 | G. RADIATION CONTROL AND SAFETY |
| 68.5 | 100.0 | [illegible] | | T. TMI INCIDENT AND SMALL |
| 9.0 | N/A | [illegible] | N/A | BREAK CONCEPT |

FINAL GRADE 90.2 %

# DO'S AND DON'TS FOR EXAMS

## DO'S

1. Read the questions carefully.
2. Note the number of points allotted to each question.
3. Question the examiner if in doubt.
4. Pace yourself - don't spend hours drawing fancy sketches.
5. Show all calculations.
6. Look for any two-part questions which may not be labeled as such.
7. Recognize whether definition or explanation (discussion) is required.
8. List more than two reasons if some or few are requested.

## DON'TS

1. LEAVE ANY BLANKS
2. Read hidden meanings into the questions.
3. Show the examiner your answers for his concurrence.
4. Write your name on every sheet.

A. PRINCIPLES OF REACTOR OPERATION (9.5)

1. The effects of Xenon are important in reactor operation.

   a. Explain the term equilibrium Xenon. (1.0)

   b. Discuss the effects on reactivity that would occur should the reactor be taken to power shortly after Xenon has peaked. (1.0)

2. Two identical reactors are taken to the "just critical" level. Reactor "A" has a rod speed of 50 steps per minute, while Reactor "B" has a rod speed of 25 steps per minute. (Assume continuous rod withdrawal). (1.5)

   a. Which reactor will achieve criticality first.

   b. Which reactor will have the highest level of source range counts at criticality.

   c. Which will have the highest critical rod height.

   Explain your answers.

3. Would the insertion of 0.1% $\Delta K/K$ to the reactor at $10^{-8}$ amps on the intermediate range result in the same change in power level as the same insertion at 80% of full power. Explain your answer. (1.0)

4. a. Sketch and explain the startup recorder trace for one minute following a rod withdrawal amounting to an increase in $K_{eff}$ (each time) of .005 from the following initial conditions: (1.5)

   I. $K_{eff}$ = 0.9, counts = 100

   II. $K_{eff}$ = 0.99, counts = 1,000

   III. $K_{eff}$ = 1.00, counts = 5,000

   b. Calculate the SUR for case III. (0.5)

5. Would control rod worth be greater: (1.5)

   a. When the moderator is at 150°F or 500°F.

   b. When it is next to a withdrawn control rod or surrounded by inserted control rods.

   c. When $C_\beta$ is 500 ppm or 1500 ppm.

A. PRINCIPLES OF REACTOR OPERATION (CONTINUED)

6. As th[illegible] is operated, plutonium 239 is gradually formed [illegible]uranium 238. Describe: (1.5)

   a. The [illegible]tion process

   b. How this formation affects reactor control

## A/. PRINCIPLES OF HEAT TRANSFER AND FLUID FLOW (8.0)

1. Briefly explain the following heat transfer and fluid flow terms: (2.5)

   a. Natural circulation

   b. Reactor coolant saturation condition

   c. Nucleate boiling

   d. Sub-cooling

2. The following units are used with what important nuclear and/or thermal parameters: (1.0)

   a. KW/ft

   b. MWD/T

   c. KW/liter

   d. $Btu/hr\text{-}ft^2$

3. Sketch a DNB curve. Label the abscissa and ordinate and identify the various regions shown on the curve. (1.5)

4. a. Describe the phenomena known as "pump cavitation". (0.5)

   b. What symptoms would alert the TMI operators to such a condition for the RCPs. (1.0)

5. a. With TMI-1 operating at full power what are the hottest and average fuel rod temperatures which exist in the core. (1.0)

   b. In the event of a LOCA, what temperature should the Zircaloy clad be limited to and for what reason. (0.5)

B. FEATURES OF FACILITY DESIGN (8.5)

1. List the purpose(s) of the Makeup and Purification System. (1.5)

2. Sketch a simplified system schematic diagram of the proposed HPI Cross-connect. Label components and indicate flow directions. (2.0)

3. Why are there two (2) vibration transducers on the DHR heat exchangers and only one (1) on the DHR pumps. (1.0)

4. With regard to the Core Flood System:

   a. Briefly describe the purpose of the system. (1.0)

   b. List normal operating pressure, temperature and volume conditions. (0.5)

   c. What system valves are controlled from the main control board. (0.5)

5. Sketch a one-line diagram of the BOP 480 volt distribution system. Indicate the systems and/or components fed by the system. (2.0)

## C. GENERAL OPERATING CHARACTERISTICS (8.0)

1. Describe how and why the following RCS chemistry parameters are controlled during startup and full-power operation. (1.5)

   a. Oxygen

   b. Chlorides

   c. pH

2. With regard to the EFW pumps, approximately how long will each pump require to reach full flow. (0.5)

3. Explain how and why the Moderator Temperature Coefficient is affected by changes in RCS boron concentration. (1.0)

4. The Reactor is operating at 10% power when the turbine bypass valves for "A" SG fail open. Two (2) minutes later the operator isolates the turbine bypass valve(s). Sketch the following parameters from the initial valve failure to four (4) minutes later for: (2.5)

   a. Reactor power

   b. SG level

   c. PRZ level

   d. FW flow

5. Describe the means of solid condition operation verification which operators can determine from the control room. (1.0)

6. a. Describe (a formula is acceptable) how the following isotopes are formed and where they would be most commonly be found in the reactor systems: (1.0)

      1) N-16

      2) SM-149

      3) Krypton-85

   b. List the half-lives of each of these isotopes. (0.5)

D. INSTRUMENTS AND CONTROLS (7.5)

1. Concerning the nuclear instrumentation:

   a. Describe the reaction by which the detectors produce a signal corresponding to neutron radiation. (1.0)

   b. Does gamma radiation affect the signals from detector. Explain why or why not. Assume detectors are properly calibrated and operated. (1.0)

2. Describe the principle of operation of the RCS Saturation Margin Monitor, including the inputs to the monitor. (1.0)

3. Upon loss of both feedwater pumps, the ICS positions the control valves EF-V30A/B to maintain SG $H_2O$ level. What level is maintained and where is this indicated:

   a. With reactor coolant pumps available. (0.5)

   b. With reactor coolant pumps not available. (0.5)

4. With regard to cold, safe shutdown, list ten (10) pertinent instruments which have been selected for placement on a separate panel outside the control room. (2.0)

5. At 90 minutes and again at 113 minutes into the TMI-2 event, operators observed anomalous increases on the intermediate range NIs.

   a. Approximately what was the order of magnitude of the increases. (0.5)

   b. Explain the cause of these increases. (1.0)

E. SAFETY AND EMERGENCY SYSTEMS (8.0)

1. a. Outline all of the Unit #1 Emergency Feedwater System modifications. (2.0)

   b. List the signals which will automatically start the "A" motor driven EFW pump and the turbine driven EFW pump. (1.0)

2. Explain the purpose of the PRZ Heater Emergency Power Supply System. (1.0)

3. What RPS trips are bypassed when in the Shutdown Bypass Mode. (1.0)

4. Recently, Crystal River Unit #3 suffered the loss of the +24 volt power supply to the non-nuclear instrumentation, with the reactor at 100% power. List the cause of the loss of voltage and briefly describe the significant events that occurred due to the condition. (2.0)

5. List the following full power RPS trip setpoints, with four (4) RCS pumps in operation: (1.0)

   a. Nuclear power (% of rated power)

   b. High Reactor coolant pressure

   c. Lo Reactor coolant pressure

   d. RCS maximum temperature

   e. High Reactor building pressure

F. STANDARD AND EMERGENCY OPERATING PROCEDURES (10.0)

1. With regard to a normal Reactor startup and approach to criticality, list: (2.5)

   a. Maximum SUR

   b. Minimum overlap between source and intermediate range indication.

   c. Action required if criticality is schieved prior to rods reaching .5 %ΔK/K below ECP. (Fill in the blank, also.)

   d. Exceptions to the rule that CRA Safety groups be at upper limits whenever positive reactivity is being inserted.

   e. Number of licensed operators in the control room.

2. Prior to TMI-1 modifications, during a transient which results in overcooling of the RCS, PRZ level decreases and the operators open MU-V16B and start a second make-up pump to restore PRZ level. With the installation of the HPI cross-connects, would such operator action be appropriate. Explain your answer. (1.0)

3. During a TMI-1 startup, in-core quadrant tilt indicates +6%. What operator action, if any, is necessary for this condition. (1.0)

4. With the plant operating at full power, certain precautions and limitations apply. Provide the following information and operator action pertaining to these: (1.5)

   a. The control room computer becomes inoperable

   b. Maximum PRZ level

   c. Minimum boron concentration

   d. Maximum core thermal power

   e. A limiting condition for operation can not be met

F. STANDARD AND EMERGENCY OPERATING PROCEDURES (CONTINUED)

5. During full power operation, an explosion and fire occurs local to the control room of Unit #1, resulting in thick, acrid smoke filling the control room. Supervision determines that evacuation is necessary. Prior to evacuation, operators must perform certain duties. List those duties. (1.5)

6. a. List the symptoms which would alert the operators to the occurrence of an OTSG tube rupture. (1.5)

   b. If HPI actuates on lo RCS pressure during the event, what immediate operator action is necessary. (0.5)

   c. In an attempt to determine which OTSG has the rupture, the Chemistry Department is directed to sample both and analyze for what types of radioactive isotopes. (0.5)

G. RADIATION CONTROL AND SAFETY (9.0)

1. It is necessary to you to work in an area where you may receive an amount of radiation which will cause you to slightly exceed your 10CFR Part 20 routine quarterly limits. Is this permitted, and if so, what conditions must be met for you to do this. (1.5)

2. List four (4) different types of radiation and give typical situations in which each may be encountered at the TMI Station. (1.5)

3. What respiratory devices would provide adequate protection against: (1.0)

   a. Radioactive gas

   b. Radioactive particles

   c. Tritium

4. A TMI plant chemtech accidently spills a freshly taken primary coolant sample on the floor.

   a. Discuss what actions he should take. (1.5)

   b. If a protable monitor reads 50 mrem/hour $\gamma$ two feet from the spill, what is the contact level of radiation. (1.0)

5. With regard to "leaky" fuel elements, how could operators detect a leak which occurs in a TMI fuel element: (1.5)

   a. In the core at full power

   b. In spent fuel storage

   c. Which is new fuel being received

6. Assume that an emergency unscheduled entrance into the reactor building is necessary. Describe what considerations (clothing, instruments, people, exposure limits) must be factored into the entry. (1.0)

T. TMI-2 INCIDENT AND SMALL BREAK CONCEPT (9.0)

1. List three objectives of the training program on the above subject which was administered to TMI and other operating B&W plant operators. (1.0)

2. Explain why the availability of steam generator feedwater and RCS pump operation have little effect in the event of a large LOCA but may have a significant effect in a small break. (1.0)

3. During the TMI-2 event, the operators had no direct indication of saturation conditions. What indirect means of determining that the condition existed were available to them. (1.0)

4. With all RCPs secured after a reactor trip, how do the TMI operators verify that natural circulation is occurring. (1.0)

5. Within the first eight minutes of the TMI-2 event the PRZ level indications went off-scale high. What was the cause of the increasing PRZ level. (0.5)

6. List four (4) objectives of the emergency core cooling system after actuation and of operator action on a loss of coolant accident. (1.5)

7. What plant indications or conditions would alert you as an operator to whether a trnasient is an overcooling situation of the RCS or a small break. (1.0)

8. A number of operating procedures contain the statement "verify emergency feedwater flow". What indications do you as an operator have with which you can verify this flow. (1.0)

9. List the major mechanical failures and errors that created or aggravated the TMI-2 incident. List minimum of four (4). (1.0)

Section A



1a Equilibrium Xenon is the term used to describe when Xenon production (from fission & $I^{135}$ decay) equals Xenon removal (from burnout & Xe decay) for a given power level. For 100% FP equilibrium xenon is worth ~ 2.7% $\Delta k/k$

b If power is increased following Xenon peak, the neutron flux increase will increase Xenon burnout term. This in conjunction with the fact Xenon [illegible] $I^{135}$ [illegible] in a triple reduction in the total [illegible] with a corresponding rapid positive reactivity [illegible]

2a Reactor A will receive criticality first. Since reactor B will be receiving twice the rate of [illegible] position will be reached in ~ ½ the time from [illegible] of initiation

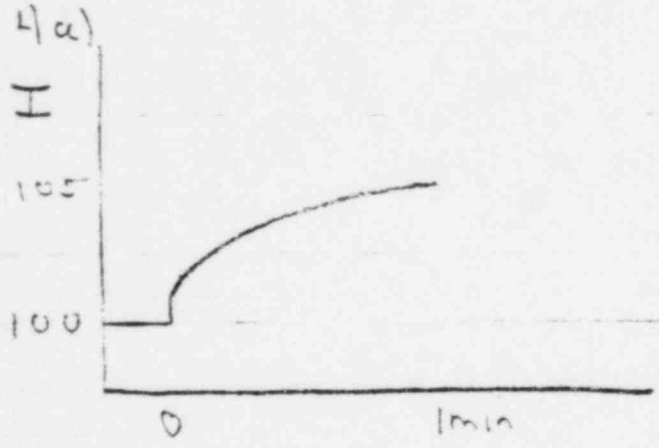
b Reactor A will have triggered the [illegible] counts. This is a result of the increased time [illegible] of generations of subcritical multiplication [illegible]

c Critical rod height will be identical. Since both reactors are identical critical rod position at $10^{-8}$ amp will be identical

Section 4 pg 2

c) [illegible] a 0.1% $\Delta k/k$ addition @ $10^{-4}$ amps in I.R. would result in a positive SUR of ~0.5 decades per minute which would increase Reactor power to the point of excessive heat production (~$10^{-2}$ amps in control) at which point doppler & moderator temperature coefficients would act negative reactive & stabilize power [illegible] ... A positive addition in reactive would immediately result in a change in fuel & moderator temp with the resultant negative reactivity addition from doppler & moderator temp. such that power would not increase significantly relative to the original experience @ $10^{-4}$ amps

4(a)




$$CR_2 = CR_1\left(\frac{1-k_1}{1-k_2}\right)$$

$$CR_2 = 100\left(\frac{1-.9}{1-.905}\right)$$

$$CR_2 = 100\left(\frac{.1}{.095}\right)$$

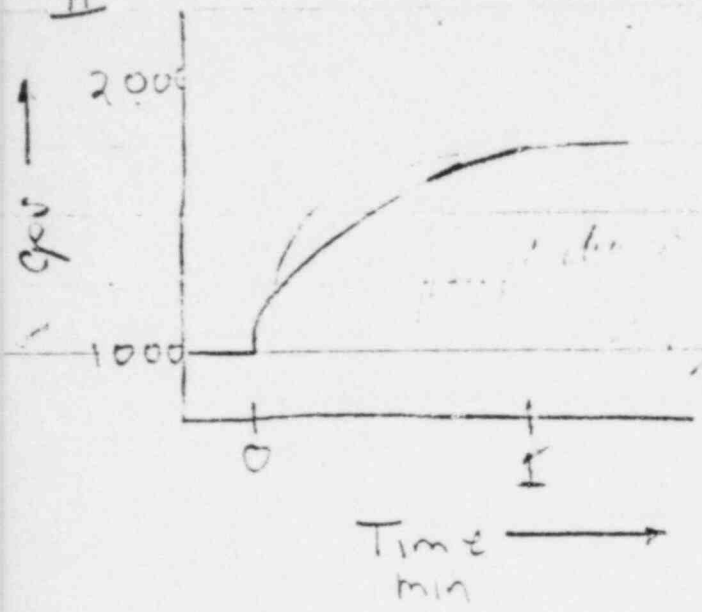
$$CR_2 = 105 \text{ cps}$$

Assuming equilibrium is nearly obtained from equilibrium

cps increase to equilibrium & stabilize as result of subcritical multiplication

Section 4 FOV

II




$$CR_2 = CR_1 \left(\frac{1-k_1}{1-k_2}\right)$$

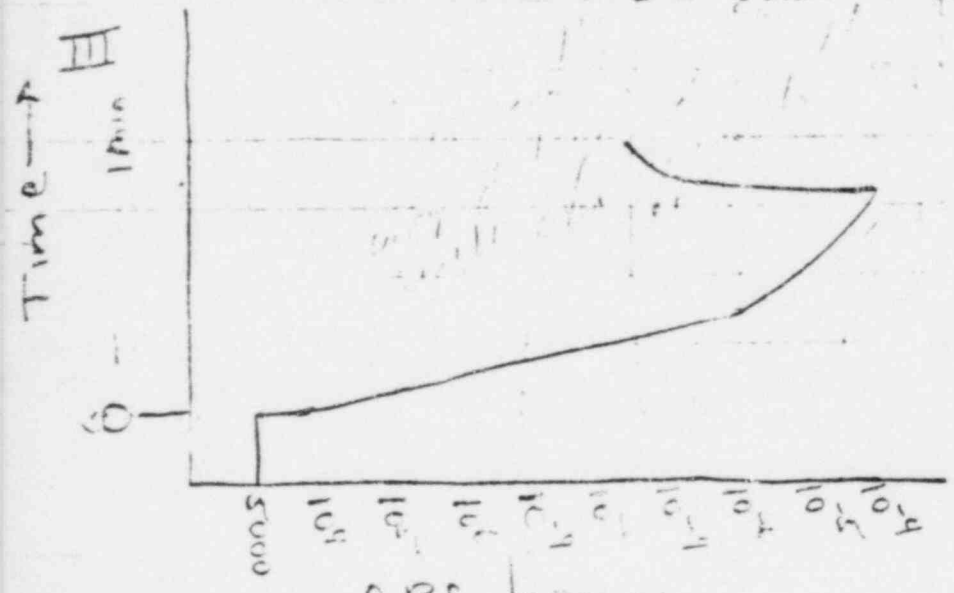
$$= 1000 \left(\frac{1-.99}{1-.995}\right)$$

$$= 1000 \frac{.01}{.005}$$

$$CR_2 = 2000 \text{ cps}$$

Assuming equilibrium

III




Decision of .005 ± 4

Rec

our understand to turn @

$\sim 10^{-6}$ A in IR due to dopp

(motion Temp Coeff

By trips @ 105.5% FP ($\sim 10^{-6}$ a)

with resistance

to become @

4b $$\Pi = \left(\Delta I / \Delta P\right) + \left(\beta - \rho / \Delta P\right)$$

$$\Pi = \left(36 \times 10^{-6} / .04 \times .0049 \pm\right) +$$

$$\left(.0055 - .0049 \pm / .04 \times .0049 \pm\right)$$

$$\Pi = \left(36 \times 10^{-6} / .00039 \pm\right) + \left(.00052 / .00039 \pm\right)$$

Assume

$\lambda = .04$

$\rho = \frac{1-k}{k} = .0049 \pm$

$\beta = .0055$,

4b cont

$\tau = .000556 / .000398$

$\tau = 1.397$

$SUR = 26.06 / \tau$

$= [illegible]$

$= 18.65$ dpm/decade/min

5a Control rod worth greater at 500°F due to decreased competition for n from xenon as result of decreased moderator density

5b Control rod worth [illegible] rod [illegible] to drawn rod due to decreased competition for n from with drawn rod

5c Rod worth is greater at [illegible] ppm than at [illegible] ppm

Sept. '11

6a

$$^{238}_{92}U + n \rightarrow {}^{239*}_{92}U \xrightarrow{\beta^-} {}^{239}_{93}Np \xrightarrow{\beta^-} {}^{239}_{94}Pu$$

6b. $^{239}Pu$ is built into the core the $\beta$ effective decreases resulting in faster response for a given reactivity change. The $\beta$ effective change is a result of the fact the $^{239}Pu$ has a $\beta$ fraction (.0021 vs .0064 of $^{235}U$) and the consumption of total power increases from BOL to EOL from 15% to 40% respectively ($^{235}U$ BOL is 98% & EOL 57% $^{235}U$ is ~97% enriched). The result is R effective decreases from ~.0064 to ~.0052 @ EOL

Sect. A' pg1

1a - Natural Circulation is the process by which flow is induced in a system without the aid of pumps as a result of a density difference in the coolant at a higher elevation, ie a water heated up its density decreases causing it to rise. If it is then cooled the density increases will cause it to [illegible]

1b Reactor coolant subcooling compares the water in the reactor at [illegible] & pressure with steam being formed in the reactor, resulting in a 2phase flow mixture & steam [illegible] of the fuel. Examine with relevant [illegible] & the temperature

1c Nucleate boiling is the [illegible] includes it surface site impartations on the [illegible] turbulent flow into the flow channel where the [illegible]

1d ✓ Subcooling is the amount by which the major portion of the coolant is below saturation conditions in the reactor. At 100% FP this is a 20°F

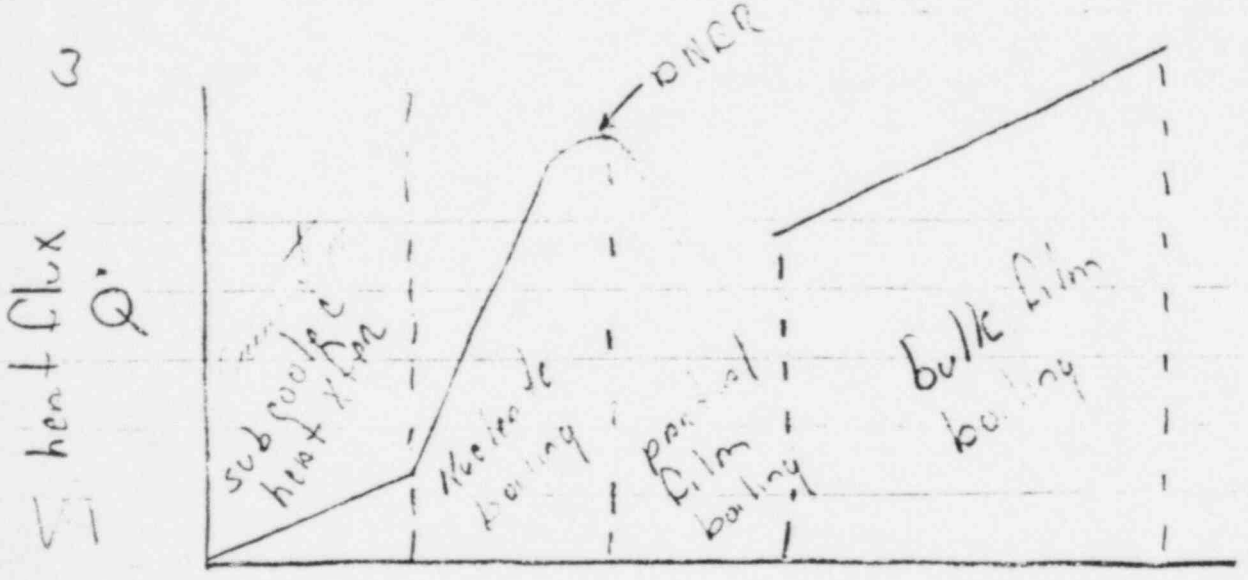
Sect H pg 2

2a) kw/ft - limited by Tech Spec to 14.2 kw/ft to prevent fuel centerline melt

b) mwd/T - Megawatt days per metric ton limited by Tech Specs to 55,000. This is a measure of fuel burnup or depletion

c) [illegible] - [illegible] fuel temperature, fuel conductivity, rod worth (control & APSR) fuel depletion

d) BTU/hr-ft$^2$ - Measure of heat transfer efficiency for heat exchangers (ie OTSG tubing) used to determine heat removal capability



Section A' pg2

4a Due to the pressure drop in the impeller of a centrifugal pump steam bubbles will begin to collapse if the Net positive Suction Head is insufficient to prevent the pressure from decreasing. This will result in vibration, flow oscillations, steam erosion of the impeller, steam blanketing of bearing surface & release of entrained gases which could damage pump &/or seal

4b RC flow reduction &/or oscillations
RC pump vibration or frequency increasing/changing
RC motor vibration increasing/changing
Decreased motor amps
Increasing pump bearing temp

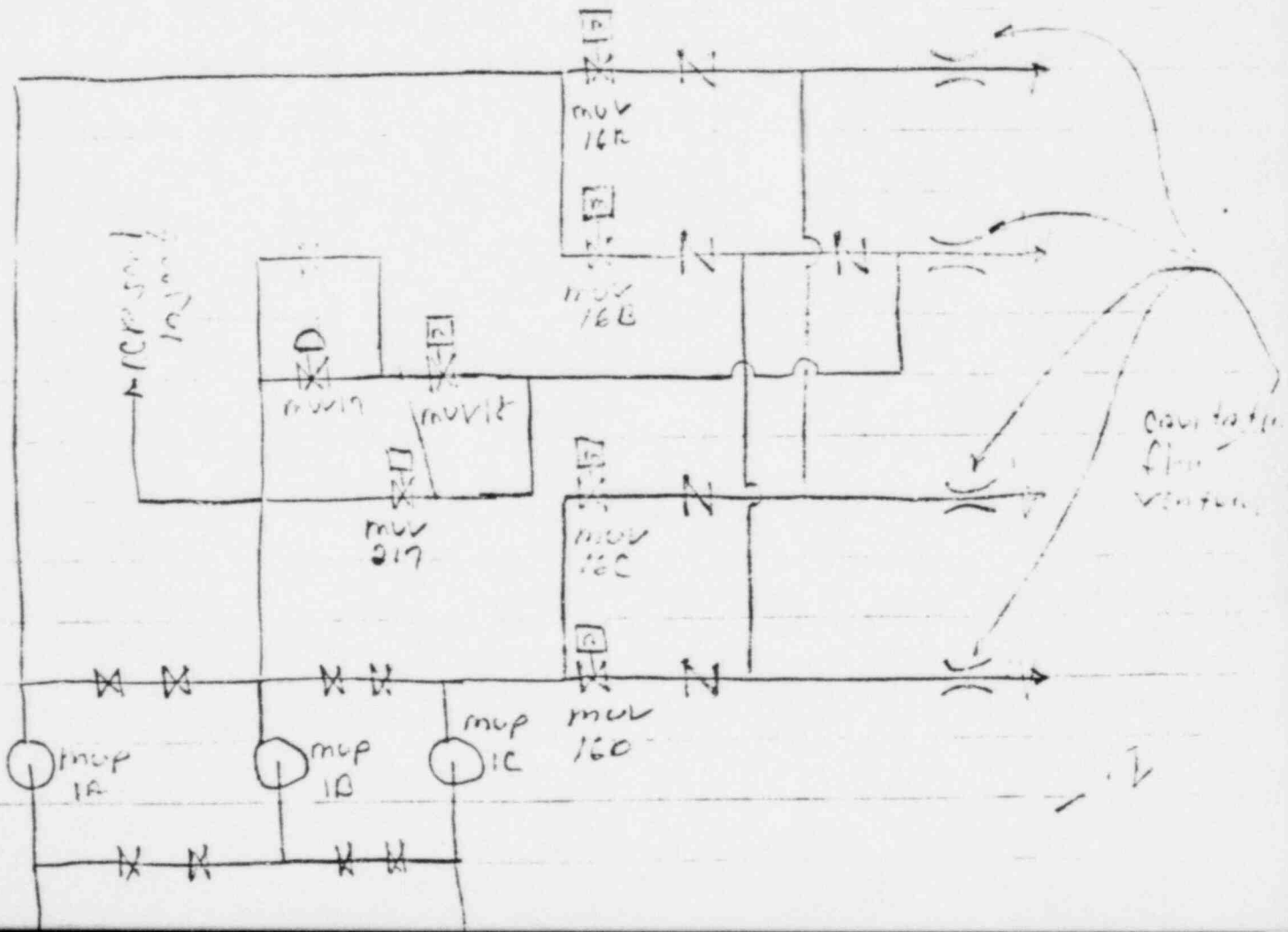
5a) Initial fuel temperature is ~3000°F peak centerline in the worst case fuel element
Average fuel temperature is ~1100 - 1200°F

5b) Cladding temperature should be limited to <2200° to ensure <1% $H_2$ formation from exothermic reaction and <17% cladding oxidation

Section B pg 1

1. RCS inventory control ✓
   RCS [illegible] control ✓
   RCS Boron control ✓
   RCS $H_2$ inventory control ✓
   Provides seal injection to RC pumps ✓
   Injection of hi concentration Boron from BWST or RCBAT or BAMT for emergency boration ✓
   - [illegible]
   to provide RC pump [illegible]
   Provide seal injection flowpath [illegible] on RC pump
   [illegible] on RC pump
2. RCS $H_2O$ quality control

2)



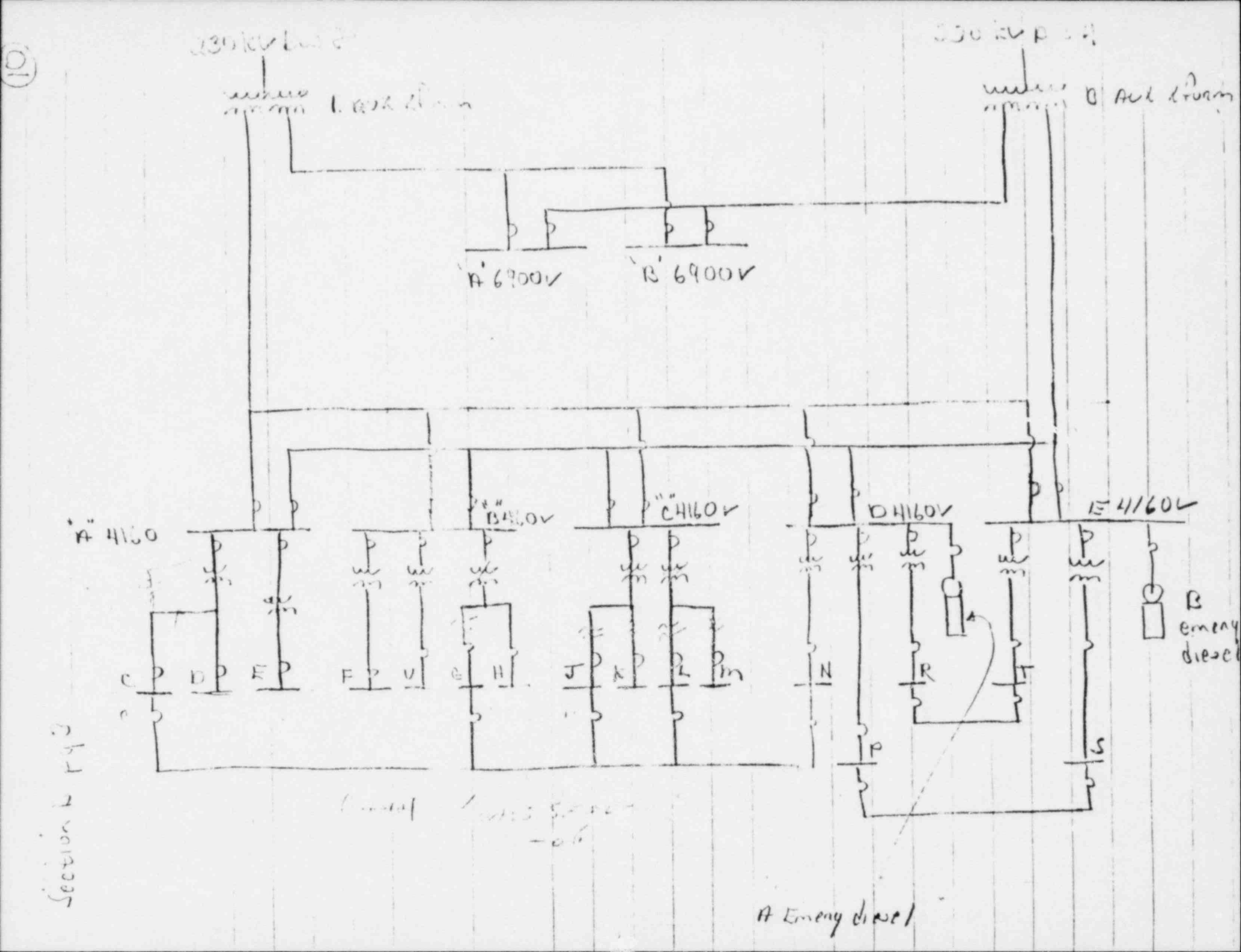
Sect B pg 2

3) Due to the possibility of debris impairing a true count of the coolers causing a leak in DFR coolers [illegible] of steam generator support pressure by flow sensors the coolers [illegible] 2 transducers to indicate that the [illegible] prior to leak occurring.

4) a Provides a means of covering & cooling the core [illegible] event of a LOCA independent of operator action, initiating signals & power supplies.

b press — [illegible]
Temp — > 110°F
Volume — 13.5 ft ± 0.5 ft corresponding to 10H0 ± 30 lb of $H_2$ @ 2270 ppm boron

c CF-V-[illegible] Core flood discharge
CF V- 2A/B
CF-V- 1A/B
CF-V- 3A/B


'A' 6900V
'B' 6900V
'A' 4160
'B' 4160V
'C' 4160V
D 4160V
E 4160V
A
B emerg diesel
A Emerg diesel

Section C pg 1 11

1a $O_2$ is controlled in the RCS by several means. Minimizing $O_2$ content of makeup water, by addition of hydrazine which acts to scavenge $O_2$, $N_2$ blanketing of [illegible] to exclude $O_2$ & by maintaining a positive $N_2$ pressure to scavenge $O_2$. Limited to < 0.1 ppm by T.S. This is necessary to minimize general corrosion & pitting & prevent Chloride stress cracking of SS as it occurs, since [illegible] in presence of $O_2$.

1b Chlorides are controlled by control of makeup to RCS & i.e. use of mu-k-light (makeup & purification demins) to remove any present. Limited to < .15 ppm by T.S. Chlorides in the presence of $O_2$ @ high temps will cause cracking of stainless steel which is under stress. Since Reactor system is primarily SS under stress from manufacture, pressure, temp, etc and the primary is @ ~570°F, This is limited to ensure system integ.

1c Li Ph control is used in the RCS. This is accomplished by means of mu-k IA/D which remove Li from RCS coolant. Li is produced from ($B^{10}$ n) interaction

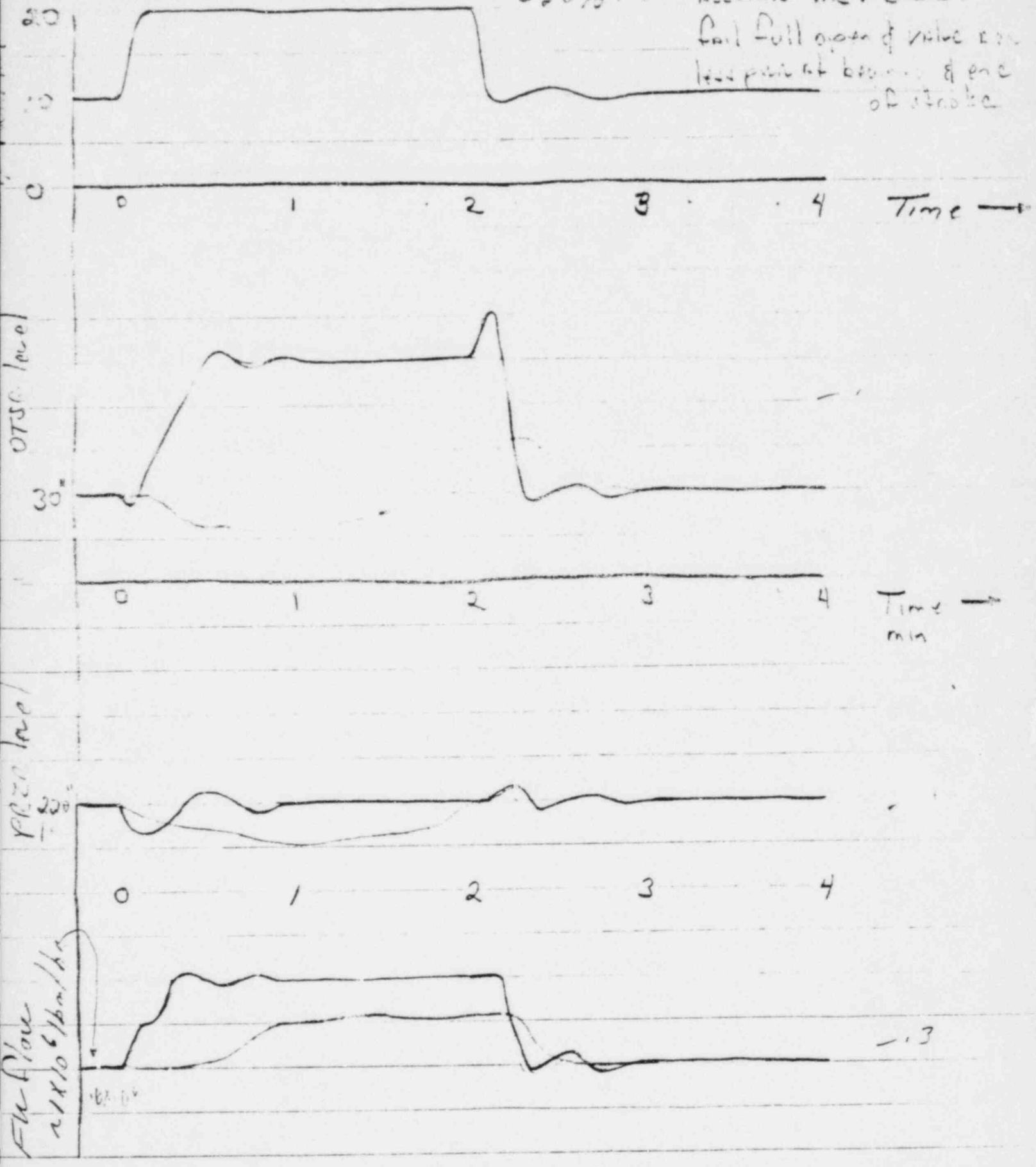
1d Ph control is required to caustic stress corrosion [illegible]

2. EFW pumps will start 5 sec after [illegible] is reached (~ 30 sec after signal is generated if not present), or will reach rated RPM @ 30 sec after start sequence is initiated. However EFV 3011/2 will [illegible] OTSG reaches set level (32" NR if [illegible] 50% in operating range if not). The Time to reach full flow for EFW pumps to OTSG is [illegible] point [illegible]

3 Moderator Temp Coefficient ($\alpha_{MT}$) becomes more negative as Boron concentration decreases. As the moderator increases in temperature, its density decreases. This density change (moderator & water) results in a [illegible] of boron or positive reactivity addition due to boron transfer. It can be seen that as boron concentration decreases [illegible] of moderator expansion will decrease less boron, with a smaller positive reactivity addition due to boron. The final result being that the negative effect of removing moderator plus the decrease in positive reactivity addition due to boron removed causes $\alpha_{MT}$ to become more negative as boron concentration decreases.

Section C-pg 2

~20% FP assume MSV 3 DEF fail full open & value exp. less point at beginning & end of stroke



5) Para |v| > 400" ✓
> 50°F Sub cooled! — Trend meter $\bar{T}_n$ vs $T_{sat}$ for RN pump
Fuzz temp → RCS history
P ... Increasing to ~ 2475 psig

6) a1 $_8O^{16} + _0n^1 \rightarrow _8O^{17*} \xrightarrow{p+\gamma} _7N^{16} \xrightarrow{\gamma+\beta} _8O^{16}$ found primarily in coolant

2) $_{60}Nd^{149} \xrightarrow{\beta} _{61}Pm^{149} \xrightarrow{\beta} _{62}Sm^{149}$ found primarily in fuel & fission product poison ✓

3) formed primarily directly from fission found primarily in fuel pins as fission gas ✓

6 b1 7.6 sec ✓
2 $10^{14}$ years ✓
3 4 1/2 hrs & 10.7 yrs

Section D pg 1

1) a) $_{5}B^{10} + {}_{0}n^{1} \rightarrow {}_{5}B^{11*} \rightarrow {}_{3}Li^{7} + {}_{2}\alpha^{4} + \gamma + 5e^{-}$

A neutron is absorbed by Boron which then decays by emission of an alpha particle, a gamma ray, & 5 electrons. The resultant current flow (Power Range or Intermediate range) or [illegible] (source range) is then a measure of the number of events occurring in the detector

b gamma radiation will result in the production of current or pulses (as sensed by the detector) However in the source range the resultant pulse is [illegible] the size of a pulse resulting from a $\alpha$ interaction. This smaller pulse can then be discriminated against (ie signal is clipped to remove the smaller pulse) electronically speaking

In the IIIc, N gamma only signal is [illegible] added to the signal produced by neutron and gamma such that the net resultant signal is neutron signal only (ie the gamma is compensated for)

In the Pwr Range the gamma signal is not considered for two reasons 1) It is proportional to power and 2) it is several orders of magnitude less than the signal resultant from neutrons

Sect. 10 pg 2

2 RCS subcooling margin monitor receives inputs from $T_h$, $T_c$, & Press. for both RCS loops. From Pressure it computes a $T_{SAT}$ and then subtracts the respective Temperature to give a subcooling margin. Two inputs to [illegible]. [illegible] < 50°F [illegible]

Section D page 3

3) a) 30" on the Steam level indication on Control Center
b) 50% on the operating range narrow indication on Control Cen

4) 1 Control Indication (position demand) ✓
2 Control Indication (position demand) ✓ ≈ 430 ✓
3 RCS hot leg Temp ✓
4 RCS [illegible] ✓
5 Pressurizer level ✓
6 Pressurizer Temp ✓
7 HPI Flow ✓
8 RWST level ✓
9 letdown Flow ✓
10 letdown temp ✓

5) a) Approximately one decade increase from $10^{-11}$ A to $\sim 10^{-10}$ A

b) This increase was due to the increased neutron flux in the core which resulted in an increase in the neutron leakage from the core seen by the detectors.

1a) motor driven EFW will auto start on [illegible]
EFW flow to OTSG added to CC & CL indications ✓
[illegible] signals changed to ✓
1 loss of all RCP
2 <50psid across EFWP1A&B
3 >200psid between EFW pump discharge & main steam pressure
4 [illegible]
EFV 30A/B will be opened & response of IC ✓
[illegible]
MSV 43A/B & MSV6 will have backup air from Backup [illegible]
MSV 42A&B will be open via DC motor [illegible] ✓

1b loss of all RCPs —
<50 psid across each EFWP1A&B ✓
>200psid between EFW pump discharge & SG pressure

2) [illegible] group of lights (labeled [illegible]) from the normal supply to Engineered Safeguards buses so that they can be energized by the emergency diesels in the event of a station blackout. The valves must be procedurally opened or placed in the energized position. Transition must be accomplished in <2hrs follow station blackout ✓

3 lo press ✓
press - Temp ✓
flux - imbalance - flow (ΔI ΔQ / flow
power to ♯ of pumps ✓
in addition hi pwr is administratively required to be reset to 65% & an RCP is secured if pressure trip @ 1720# RC pressure is reached

4 NNI voltage loss was due to a short circuit in the connection for the Test meter. This resulted in the RCBV & spray valve going full open. It caused Rod withdrawal (Tave low due to all control rods causing withdrawal) Feedwater was run off due to ΔTv limits ($T_h$ low & RC flow low due to RCP trip) RC pressure rapidly initiated causing the reactor to trip on hi pressure. The OTSG's boiled down & secondary steam relieved to atmosphere THPI actuated due to decreasing RC press & the operator throttled down flow toward the RCS to avoid increasing pressure to actuate RC drain tk vlvs & rupture disc - allow primary release to RB & RB pressure to increase

SECT E pg 9

5 a 105 5% FP
b 2200 ±
c presently 1600 ± will be changed to 1900 ± ✓
d 619° F ✓
e 4 ±

Section = ps1

1 a 1dpm steady state not to exceed 1st open timer

b &1 decade in the range $10^{-4}$ to $10^{-6}$ cps in SR & $10^{-11}$ to $10^{-5}$ in sour

c .3% Δk/k

insert rods till 1% s/d

Recirculate RCP

d during physics testing

operation with an inoperable/degraded loop in mode -3

e 2 of 4 which will have a SRO license

2) No since this would result in an undue transient on the plant or D hyd injection nozzle due to the x-tie. The proper action would be to open mov-v-21 which trips the E inj on the [illegible] valve (ie shut down common x-tie & makeup) & start a second makeup pump if required

3) This would require power to be reduced below the P-8 level cutoff. In addition the power range trip setpoints must be reduced 2% for each 1% tilt in excess of the limit (limit is 3.52%) If tilt is not corrected within 4 hrs in addition RPS setpoint for 4/4 loop must be reduced 2% for each 1% tilt, Rod insertion limits must be reduced 2% for each 1% tilt in excess of limit & the operational maneuver limit must be

Sect. TY-

3 (cont). decreased by 2% for each 1% rod in excess of [illegible]

4 a) [illegible] hand & calculation each 6 hrs, hand heat balance [illegible]
& RCS leak rate each day by hand...

b) [illegible] if greater shutdown [illegible]

c) 25 psig — if less shutdown [illegible]

d) 4535 interlock - reduce pwr to ≤2535 if greater than

e) [illegible] shutdown of [illegible]

f) [illegible] RC by [illegible]

g) [illegible]

5) Trip Reactor & Turb -

[illegible]

Start EFP 2 H/D -

Trip FW P 1 H/D

Open MOV-51 -

Commence emergency operation with standard shutdown [illegible]

Close MOV-3 -

Leave charging & injection in auto

[illegible] 2

6a) Trip-T increase alert alarm -

Incore alert alarm -

RCS pressure decreasing -

Pzr level decreasing -

CTMT level increasing -

Secondary pressure [illegible] & steam

b trip all RCP breakers to 1202-6A leak valve

auto SI initiation follow up action

- c $I^{131}$, $\alpha$, long lived gas/aerosol (pressure 15 min ago
[illegible] $I^{131}$

Section C pg 1

1 ~~Yes~~ proceed as the team A is complete, but we must [illegible] Supervisor instructed

2 Alpha ($\alpha$) handles new fuel ~~Unfueled~~ UNFUELED FUEL [illegible]

gamma ($\gamma$) inside chimney at peak ($\eta$: $\gamma$)
neutron ($n^0$) inside [illegible]

3 a Full face Scott air ~~mask~~ [illegible]
b Scott air mask with Hepa filter (full face mask)
c Scott air pack plus

4 a Assume [illegible] Worker simple tasks [illegible]
So does not constitute a local emergency how he should stop [illegible] Room clean it up using proper radiology [illegible] if monitor [illegible] clean

b Assuming the spill constitute a point source due to its small area then

$$\text{If } DR_1 \times D_1^2 = DR_2 \times D_2^2$$

$$DR_2 = (DR_1 \times D_1^2) / D_2^2$$

-1)

4b. $DR_2 = 50\left[\frac{(24'')^2}{(2'')^2}\right]$ Assume contact reading @ 2"

$DR_2 = 7.2$ Rem/hr -

5a) by $I^{132}/I^{131}$ ratio, RMCS Sequelby, RM L1 for knife leaks -.2

b) pg 4 page 13 post LOCA analysis -.4

c) By Alpha survey on receipt Sample Air & Count -.2

6) Emergency [illegible] response personnel depending on purpose of entry. More personnel may be required if repairs are to be effected personnel rotated etc We [illegible] double probe may be required if RCS leak has [illegible] cooled. Respirator requirements based on expected [illegible] concentrations are [illegible] to minimize. They should take as min a RO-2 & Teletector. Exposure should be limited to the guidelines of 10CFR20 unless [illegible] approved (50Rem for life or 25 rem to skin every once in a life time exposure)

Sect 7 pg 1 -.1 25

1a) 1) Train operators to recognize importance of maintaining subcooling
2) Train operators prompt response to small breaks
3) Improve operator response & handling of small breaks

2) In a small break continued operation of RCP saturation will cause an increase in the amount of void in the loop which will cause the break flow to decrease and the steam only will be existing
In addition Feedwater either normal or emergency is required to provide a heat sink.
-.4 In the generations for the RCS to insure subcooling is maintain and/or reconcense steam & maintain in the RCS
ECCS can't handle cooling in small break - and OTSG but removal

Sect T pg 2 (1.5) 26

3) $T_h$ versus RCS pressure
Log of Subcooled margin versus RCS pressure
Para Temp versus $T_h$
RCPump cavitation – ↓ in flow
increase vibration
decrease amps

Increasing SR ops – due to voiding / steam formation in core

4) 20 to 40 ΔT ($T_h - T_c$)
$T_h$ decreasing
OTSG pressure & saturation on $T_h$ and Subcooling
Incore thermocouple temperature accuracy

5) The przr level increase since the top of the przr was at less than RCS pressure so that water and heat from RCS to Pressurizer due to temperature rise

6) maintain clad temp <2200°F
prevent >1% $H_2$ generation from Zirc-water reaction
Maintain core in a coolable geometry
provides long term decay heat removal & prevents S/G
prevent >17% oxidation of cladding
Isolate & cool RB to contain activity

7) FW flow rate – IF RCP TDP occurs
Steam pressure: constant = LOCA
ΔT ($T_h - T_c$) IF DECREASING, SUBCOOLING
Subcooling margin

Nov

| M | T | W | T | F | S | S |
|---|---|---|---|---|---|---|
| 3 | | | | | | |
| M 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| J 3 | 3 | 3 | 3 | 3 | 0 | 0 |
| 10 | | | | | | |
| M 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| J 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 17 | | | | | | |
| M 1 | 0 | 0 | 2 | 2 | 2 | 2 |
| J 1 | 0 | 0 | 2 | 2 | 2 | 2 |
| 24 | | | | | | |
| M 2 | 2 | 2 | 0 | 0 | 3 | 3 |
| J 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| M | | | | | | |
| J | | | | | | |
| M | | | | | | |
| J | | | | | | |

Sect T pg 3

(13)

27

ETS flow indication (to be made up) ✓

[illegible] ✓

[illegible] position "

OTSG level ✓ & pressure

a) [illegible] open & operator not following Tech Spec Limit
meant it was open

[illegible]

over leaving of OTSG when empty to remove
[illegible] (>2 months etc.) & then try to
them when system was up & running

Not recognizing System was @ temperature

B3 Surge tk over boundary not violated

= .2

| | M | T | W | T | F | S | S |
|---|---|---|---|---|---|---|---|
| SEPT | 1 | | | | | | |
| | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| | 3 | 3 | 3 | 3 | 3 | 0 | 0 |
| | 8 | | | | | | |
| | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| | 1 | 1 | 0 | 2 | 2 | 2 | 2 |
| | 15 | | | | | | |
| | 1 | 1 | 1 | 0 | 0 | 3 | 3 |
| | 2 | 2 | 2 | 3 | 3 | 0 | 0 |
| | 22 | | | | | | |
| | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| | 3 | 3 | 3 | 3 | 3 | 0 | 0 |
| | 29 | | | | | | |
| OCT | 1 | 0 | 0 | 2 | 2 | 2 | 2 |
| | 0 | 0 | 2 | 1 | 1 | 0 | 0 |
| | 6 | | | | | | |
| | 2 | 2 | 2 | 0 | 0 | 3 | 3 |
| | 3 | 0 | 0 | 2 | 2 | 2 | 2 |
| | 13 | | | | | | |
| | 4 | 1 | 1 | 1 | 1 | 0 | 0 |
| | 2 | 2 | 2 | 2 | 0 | 3 | 3 |
| | 20 | | | | | | |
| | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| | 3 | 0 | 0 | 2 | 2 | 2 | 2 |
| | 27 | | | | | | |
| | 4 | 1 | 1 | 1 | 1 | 0 | 0 |
| | 2 | 2 | 2 | 2 | 0 | 3 | 3 |