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Exelon Nuclear

May 21, 2001

10 CFR 50.4

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

LaSalle County Station, Units 1 and 2
Facility Operating License Nos. NPF-11 and NPF-18
NRC Docket Nos. 50-373 and 50-374

Subject: Unit 1 Cycle 9 and Unit 2 Cycle 9 Core Operating Limits Reports (COLR)

Reference: Letter from Stewart N. Bailey (NRC) to Oliver D. Kingsley (Exelon), "Issuance of Amendments (TAC Nos. MA8388 and MA8390)", dated March 30, 2001.

LaSalle County Station Units 1 and 2 have implemented Improved Technical Specifications (ITS), which were approved on March 30, 2001 by the NRC in Amendments 147 and 133 to Facility Operating Licenses NPF-11 and NPF-18, respectively. To support operation with ITS, revisions to the LaSalle County Station Units 1 and 2 Core Operating Limits Reports (COLRs) are necessary to incorporate the results of the cycle-specific analyses for the current operating cycles (L1C9 and L2C9). Included in these cycle specific analyses is resolution of a coding error, identified by Framatome ANP (formerly Siemens), that impacted thermal limit values.

In addition, the Rod Block Monitor (RBM) trip setpoint and allowable value equations in the COLRs are being revised to support operation with Maximum Extended Load Line Limit Analysis (MELLLA). Other administrative changes have also been incorporated.

In accordance with Improved Technical Specification Section 5.6.5, "Core Operating Limits Report," and 10 CFR 50.4, "Written Communications," Exelon Generating Company, (EGC), LLC, LaSalle County Station is submitting these COLRs to the NRC.

AP01

Should you have any questions concerning this letter, please contact Mr. William Riffer, Regulatory Assurance Manager, at (815) 357-6761, extension 2383.

Respectfully,

Charles G. Pardee
Site Vice President
LaSalle County Station

Attachments: Unit 1 Cycle 9 Core Operating Limits
Unit 2 Cycle 9 Core Operating Limits

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - LaSalle County Station

Technical Requirements Manual

Appendix I

(Amendment 45)

LaSalle Unit 1 Cycle 9

Core Operating Limits Report

and

Reload Transient Analysis Results

May 2001

Section 1

LaSalle Unit 1 Cycle 9

Core Operating Limits Report

May 2001

Issuance of Changes Summary

Affected Section	Affected Pages	Summary of Changes	Date
All	All	Original Issue (Cycle 9)	10/99
All	All	Incorporated administrative changes (including updating the date to be November 1999)	11/99
All	All	Incorporated changes to thermal limits due to uprate and MELLLA operation, revised LHGR and MAPLHGR limits, CBH penalties, and necessary administrative changes.	5/00
All	All	Incorporated ITS changes, RBM trip setpoint and allowable value equation change for DLO and SLO, TIP symmetry Chi-Squared testing, added information on the use of SUBTIP that allows operation with reduced number of TIPs, incorporated the results of revised thermal limits with correct thermal conductivity and ITS scram times, and other necessary administrative changes.	5/01

Table of Contents

References

1. Commonwealth Edison Company Docket No. 50-373, LaSalle County Station, Unit 1 Facility Operating License, License No. NPF-11.

2. Letter from D. M. Crutchfield to All Power Reactor Licensees and Applicants, Generic Letter 88-16; Concerning the Removal of Cycle-Specific Parameter Limits from Tech Specs, dated October 4, 1988.

3. LaSalle Unit 1 Cycle 9 Neutronics Licensing Report (NLR), NDIT NFM9900149, Sequence No. 00, October 1999.

4. LaSalle Unit 1 Cycle 9 Reload Analysis, EMF-2276, Revision 1, October, 1999.

5. LaSalle Unit 1 Cycle 9 Plant Transient Analysis, EMF-2277, Revision 1, October, 1999.

6. LOCA Break Spectrum Analysis for LaSalle Units 1 and 2, EMF-2174(P), March 1999.

7. LaSalle LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM-9B fuel, EMF-2175(P), March 1999.

8. LaSalle Extended Operating Domain (EOD) and Equipment Out of Service (EOOS) Safety Analysis for ATRIUM-9B Fuel, EMF-95-205(P), Rev. 2, June 1996.

9. ARTS Improvement Program analysis for LaSalle County Station Units 1 and 2, NEDC-31531P, December 1993 and Supplement 1, June 1998 (Removal of Direct Scram Bypassed Limit).

10. Lattice-Dependent MAPLHGR Report for LaSalle County Station Unit 1 Reload 7 Cycle 8, 24A5180AA Revision 0, December 1995.

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14. "Project Task Report, LaSalle County Station, Power Uprate Evaluation, Task 407: ECCS Performance," GE report number GE-NE-A1300384-39-01, Revision 0, Class 3, dated September 1999.

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18. "TIP Symmetry Testing", JHR:97:021, J.H. Riddle to R. Chin, January 20, 1997 and "TIP Symmetry Testing", DEG:99:085, D.Garber to R. Chin, March 23, 1999

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20. "On-Site and Off-Site Reviews of the GE Turbine Control Valve Slow Closure Analysis", T.Rieck to G.Spedl, NFS:BSS:93-117, May 19, 1993.

21. "LaSalle Units 1 and 2 Operating Limits with Multiple Equipment Out of Service (EOOS)", NFS:BSA:95-024, April 6, 1995.

22. NFM Calculation No. BSA-L-99-07, MAPFACf Thermal Limit Multiplier for 105% Maximum Core Flow

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24. "ComEd GE9/GE10 LHGR Improvement Program" J11-03692-LHGR, Revision 1, February 2000.

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1. Average Planar Linear Heat Generation Rate (APLHGR) (3.2.1)

1.1 Tech Spec Reference:
Tech Spec 3.2.1

1.2 Description:

1.2.1 GE Fuel

The MAPLHGR Limit is determined using the applicable Lattice-Type MAPLHGR limits from Tables 1.2-1, 1.2-2, 1.2-3, and 1.2-4. For Single Reactor Recirculation Loop Operation, the MAPLHGR limits in Tables 1.2-1, 1.2-2, 1.2-3, and 1.2-4 are multiplied by the MAPFAC multipliers provided in Figures 1.2-1 and 1.2-2.

Table for Fuel-Type MAPLHGR Limits	Fuel Type (Reference 3)	Cycle First Inserted
1.2-1	GE9B-P8CWB322-11GZ-100M-150-T	7
1.2-2	GE9B-P8CWB320-9GZ-100M-150-T	7
1.2-3	GE9B-P8CWB343-12GZ-80M-150-T	8
1.2-4	GE9B-P8CWB342-10GZ-80M-150-T	8

1.2.2 SPC Fuel

The MAPLHGR Limit is the Lattice-Type MAPLHGR Limit. The Lattice-Type Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limits are determined from the table given below:

Fuel Type (References 3 and 4)	Cycle First Inserted
SPCA9-393B-16GZ-100M	9
SPCA9-396B-12GZB-100M	9
SPCA9-384B-11GZ6-80M	9
SPCA9-396B-12GZC-100M	9

Planar Average Exposure (GWd/MTU) (References 4 and 7)	MAPLHGR (kW/ft) (all Siemens fuel types)
0.0	13.5
20.0	13.5
61.1	9.39

For single loop operation (or Abnormal Idle Loop Startup, UFSAR 15.4.4), the MAPLHGR multiplier for SPC fuel is 0.90. (References 4, 6 and 7)

Table 1.2-1

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB322-11GZ-100M-150-T

(References 11 and 24)

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (KW/ft)					
0	12.74	12.09	11.65	11.25	12.11	12.74
200	12.67	12.13	11.70	11.32	12.15	12.67
1000	12.48	12.22	11.83	11.46	12.25	12.48
2000	12.42	12.35	12.00	11.61	12.39	12.42
3000	12.41	12.48	12.14	11.77	12.54	12.41
4000	12.44	12.62	12.28	11.94	12.70	12.44
5000	12.46	12.77	12.43	12.11	12.86	12.46
6000	12.49	12.90	12.58	12.29	13.02	12.49
7000	12.51	13.03	12.73	12.46	13.19	12.51
8000	12.54	13.16	12.88	12.64	13.33	12.54
9000	12.55	13.30	13.01	12.82	13.43	12.55
10000	12.57	13.42	13.12	12.98	13.44	12.57
12500	12.41	13.41	13.08	13.04	13.40	12.41
15000	12.04	13.05	12.78	12.77	13.06	12.04
20000	11.27	12.38	12.16	12.16	12.40	11.27
25000	10.49	11.74	11.51	11.51	11.76	10.49
27215.6	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	733	1817	1818	1819	1820	1821

Table 1.2-2

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB320-9GZ-100M-150-T

(References 11 and 24)

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (kw/ft)					
0	12.74	12.05	11.62	11.10	12.09	12.74
200	12.67	12.09	11.64	11.15	12.14	12.67
1000	12.48	12.19	11.73	11.27	12.25	12.48
2000	12.42	12.32	11.86	11.44	12.39	12.42
3000	12.41	12.44	11.99	11.62	12.53	12.41
4000	12.44	12.57	12.13	11.80	12.67	12.44
5000	12.46	12.70	12.27	11.96	12.81	12.46
6000	12.49	12.83	12.42	12.09	12.89	12.49
7000	12.51	12.97	12.54	12.23	12.98	12.51
8000	12.54	13.07	12.62	12.37	13.07	12.54
9000	12.55	13.15	12.70	12.51	13.15	12.55
10000	12.57	13.20	12.77	12.66	13.22	12.57
12500	12.41	13.19	12.70	12.67	13.20	12.41
15000	12.04	12.89	12.40	12.40	12.90	12.04
20000	11.27	12.29	11.82	11.82	12.30	11.27
25000	10.49	11.69	11.25	11.25	11.70	10.49
27215.6	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	733	1812	1813	1814	1815	1816

Table 1.2-3

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB343-12GZ-80M-150-T

(References 10 and 24)

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (kw/ft)				
0	12.66	11.69	11.37	10.92	12.66
200	12.59	11.71	11.43	10.99	12.59
1000	12.40	11.78	11.55	11.13	12.40
2000	12.34	11.95	11.72	11.33	12.34
3000	12.34	12.16	11.91	11.54	12.34
4000	12.37	12.40	12.11	11.76	12.37
5000	12.40	12.67	12.32	12.00	12.40
6000	12.43	12.90	12.53	12.24	12.43
7000	12.46	13.05	12.76	12.49	12.46
8000	12.48	13.21	12.98	12.75	12.48
9000	12.50	13.37	13.13	13.01	12.50
10000	12.51	13.54	13.30	13.22	12.51
12500	12.35	13.75	13.60	13.57	12.35
15000	11.98	13.48	13.23	13.21	11.98
20000	11.20	12.71	12.40	12.37	11.20
25000	10.42	11.92	11.60	11.57	10.42
27215.6	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000
Lattice No.	732	2083	2084	2085	2086

Table 1.2-4

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB342-10GZ-80M-150-T

(References 10 and 24)

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (kw/ft)					
0	12.66	12.04	12.25	11.72	12.09	12.66
200	12.59	12.08	12.28	11.77	12.12	12.59
1000	12.40	12.16	12.35	11.87	12.22	12.40
2000	12.34	12.28	12.45	12.00	12.37	12.34
3000	12.34	12.42	12.55	12.13	12.53	12.34
4000	12.37	12.57	12.65	12.27	12.70	12.37
5000	12.40	12.73	12.76	12.41	12.88	12.40
6000	12.43	12.89	12.87	12.56	13.07	12.43
7000	12.46	13.06	12.98	12.72	13.27	12.46
8000	12.48	13.24	13.10	12.88	13.47	12.48
9000	12.50	13.42	13.21	13.05	13.65	12.50
10000	12.51	13.61	13.31	13.21	13.76	12.51
12500	12.35	13.79	13.35	13.31	13.82	12.35
15000	11.98	13.50	13.06	13.05	13.51	11.98
20000	11.20	12.79	12.47	12.45	12.79	11.20
25000	10.42	11.95	11.67	11.63	11.95	10.42
27215.6	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	732	2087	2088	2089	2090	2091

Figure 1.2-1 Power-Dependent SLO and Abnormal Idle Loop Startup MAPLHGR Multipliers for GE Fuel, $MAPFAC_P$

(Reference 9 and 24)

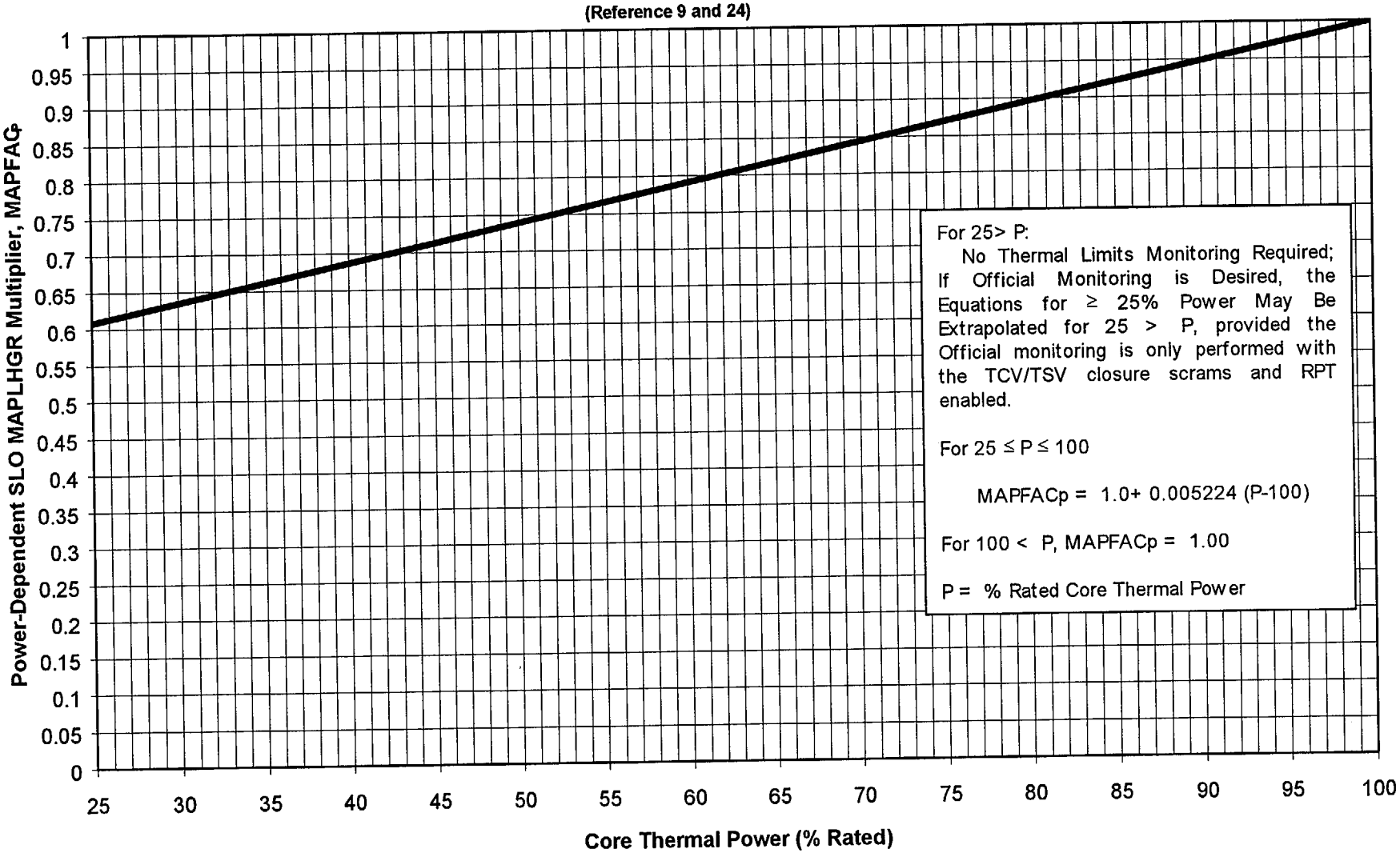
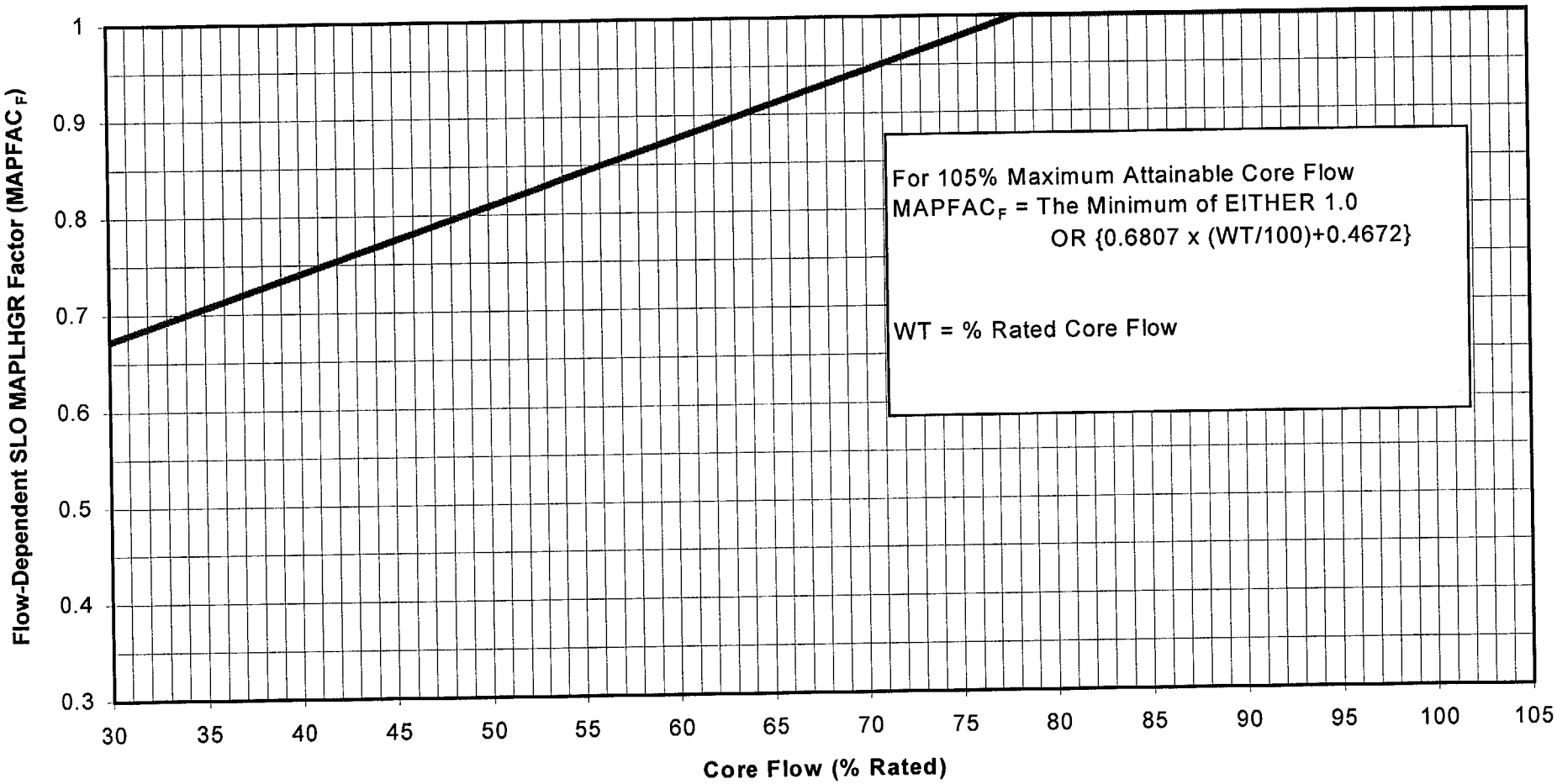


Figure 1.2-2 Flow-Dependent SLO and Abnormal Idle Loop Startup MAPLHGR Multiplier for GE Fuel, $MAPFAC_F$

(References 9, 17, 22, and 24)



2. Minimum Critical Power Ratio (3.2.2)

2.1 Tech Spec Reference:

Tech Spec 3.2.2.

2.2 Description:

Prior to initial scram time testing for an operating cycle, the MCPR operating limit is to be based on the Technical Specification Scram Times. For Technical Specification requirements refer to Technical Specification table 3.1.4-1.

TIP symmetry Chi-squared testing shall be performed prior to reaching 500 MWd/MTU to validate the MCPR calculation.

MCPR limits from BOC to Coastdown are applicable up to a core average exposure of 29,439 MWd/MTU (which is the licensing basis exposure used by SPC). (Reference 4)

2.2.1 Manual Flow Control MCPR Limits

The Governing MCPR Operating Limit while in Manual Flow Control is either determined from 2.2.1.1 or 2.2.1.2, whichever is greater at any given power, flow condition.

2.2.1.1 Power-Dependent MCPR ($MCPR_P$)* (Reference 3, 4, and 23)

2.2.1.1.1 GE Fuel
Table 2-1 gives the $MCPR_P$ limit as a function of core thermal power for Tech Spec Scram Speeds.

2.2.1.1.2 Siemens Fuel
Table 2-2 gives the $MCPR_P$ limit as a function of core thermal power for Tech Spec Scram Speeds.

Note that the 10B rods are defined by the control cell locations 14-39, 22-15, 46-23, 38-47, 14-23, 38-15, 46-39, and 22-47.

2.2.1.2 Flow-Dependent MCPR ($MCPR_F$) (Reference 4)
Table 2-3 gives the $MCPR_F$ limit as a function of flow.

2.2.2 Automatic Flow Control MCPR Limits
Automatic Flow Control MCPR Limits are not provided for L1C9.

* For thermal limit monitoring cases at greater than 100%P, the 100% power MCPRp limits should be applied.

Table 2-1

$MCPR_P$ for GE Fuel

(References 3, 4, 5 and 54)

Operation from BOC to Coastdown**

Percent Core Thermal Power*

EOOS Combination	0	25	25 (25.1)	60	80	80 (80.1)	100
No EOOS	2.70	2.20	2.10	1.57	1.53		1.50
Single RR Loop only	2.71	2.21	2.11	1.58	1.54		1.51
EOOS***	2.85	2.35	2.35		1.71	1.69	1.58
EOOS***/Single RR Loop	2.86	2.36	2.36		1.72	1.70	1.59

* Values are interpolated between relevant power levels. For operation at exactly 25% or 80% CTP, the more limiting value is used. 3489 MWt is rated power.
** Coastdown thermal limits are not provided in this COLR.
*** Allowable EOOS conditions are listed in Section 5.

Table 2-2

$MCPR_P$ for Siemens Fuel

(References 3, 4, 5, 23 and 54)

FOR OPERATION AT EXPOSURES OF 11000 MWD/MTU TO COASTDOWN**

All SPC fuel except fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25 (25.1)	60	80	80 (80.1)	100
No EOOS	2.70	2.20	2.05	1.56	1.51		1.46
Single RR Loop only	2.71	2.21	2.06	1.57	1.52		1.47
EOOS***	2.85	2.35	2.35		1.67	1.64	1.54
EOOS***/Single RR Loop	2.86	2.36	2.36		1.68	1.65	1.55

SPC fuel that is fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25 (25.1)	60	80	80 (80.1)	100
No EOOS	2.74	2.24	2.09	1.60	1.55		1.48
Single RR Loop only	2.75	2.25	2.10	1.61	1.56		1.49
EOOS***	2.89	2.39	2.39		1.71	1.66	1.56
EOOS***/Single RR Loop	2.90	2.40	2.40		1.72	1.67	1.57

* Values are interpolated between relevant power levels. For operation at exactly 25% and 80% CTP, the more limiting value is used. 3489 MWt is rated power.
** Coastdown thermal limits are not provided on this COLR.
*** Allowable EOOS conditions are listed in Section 5.

Table 2-3

$MCPR_F$ for GE and Siemens Fuel

(References 4 & 5)

MCPRf limits for 105% Maximum Attainable Core Flow

Flow (% rated)	MCPRf ATRIUM-9B	MCPRf GE9
0	1.93	1.93
30	1.93	1.93
102.5	1.14	1.14
105	1.11	1.11

The MCPRf limits are applicable from BOC through coastdown and in all EOOS scenarios.

3. Linear Heat Generation Rate (3.2.3)

3.1 Tech Spec Reference:

Tech Spec 3.2.3.

3.2 Description:

3.2.1 GE Fuel

a. The LHGR Limit is the product of the LHGR Limit in the following tables and the minimum of either the power dependent LHGR Factor*, $LHGRFAC_P$ or the flow dependent LHGR Factor, $LHGRFAC_F$. The LHGR Factors ($LHGRFAC_P$ and $LHGRFAC_F$) for the GE fuel is determined from Figures 3.2-1 through 3.2-3. The following LHGR limits apply for the entire cycle exposure range: (References 9, 14 and 24)

1. GE9B-P8CWB322-11GZ-100M-150-T (bundle 3861 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.34	14.40
26.80	12.31
33.07	11.82
38.58	11.35
44.09	10.94
49.11	10.80
60.89	6.00

2. GE9B-P8CWB320-9GZ-100M-150-T (bundle 3860 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.14	14.40
26.19	12.31
48.16	10.80
59.93	6.00

3. GE9B-P8CWB343-12GZ-80M-150-T (bundle 3866 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.33	14.40
27.86	12.31
49.76	10.80
61.18	6.00

4. GE9B-P8CWB342-10GZ-80M-150-T (bundle 3867 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.71	14.40
27.52	12.31
49.54	10.80
60.95	6.00

3.2.2 Siemens Fuel

The LHGR Limit is the product of the Steady-State LHGR Limit and the minimum of either the power dependent LHGR Factor*, $LHGRFAC_P$ or the flow dependent LHGR Factor, $LHGRFAC_F$. The Steady-State LHGR limits are given below (Reference 4). $LHGRFAC_P$ is determined from Table 3-1. $LHGRFAC_F$ is determined from Table 3-2. SPC LHGRFAC multipliers in this COLR are applicable up to a core average exposure of 29,439 MWd/MTU (which is the licensing basis exposure used by SPC). (Reference 4)

Siemens Fuel Steady-State LHGR Limits for the following fuel types:

1. SPCA9-393B-16GZ-100M
2. SPCA9-396B-12GZB-100M
3. SPCA9-384B-11GZ6-80M
4. SPCA9-396B-12GZC-100M

LHGR limits for all SPC fuel from BOC to Coastdown
(excluding fuel type 36 in 10B locations from rod pattern targeted for approximately 9000 MWD/MTU to rod pattern targeted approximately for 12,000MWD/MTU)

Planar Average Exposure (GWd/MTU) (Reference 4)	LHGR limit (kW/ft)
0.0	14.4
15.0	14.4
61.1	8.32

LHGR limits for SPC fuel type 36 in 10B locations
(from rod pattern targeted at approximately 9000 MWD/MTU to rod pattern targeted at approximately 12,000 MWD/MT)

Planar Average Exposure (GWd/MTU) (References 4 and 23)	LHGR limit (kW/ft)
0.0	14.05
15.0	14.05
61.1	7.97

Note that the 10B rods are defined by the control cell locations 14-39, 22-15, 46-23, 38-47, 14-23, 38-15, 46-39, and 22-47.

* For thermal limit monitoring cases at greater than 100%P, the 100% power LHGRFACp limits should be applied.

Figure 3.2-1 Power-Dependent LHGR Multipliers for GE fuel (formerly $MAPFAC_P$)

(Reference 9 and 24)

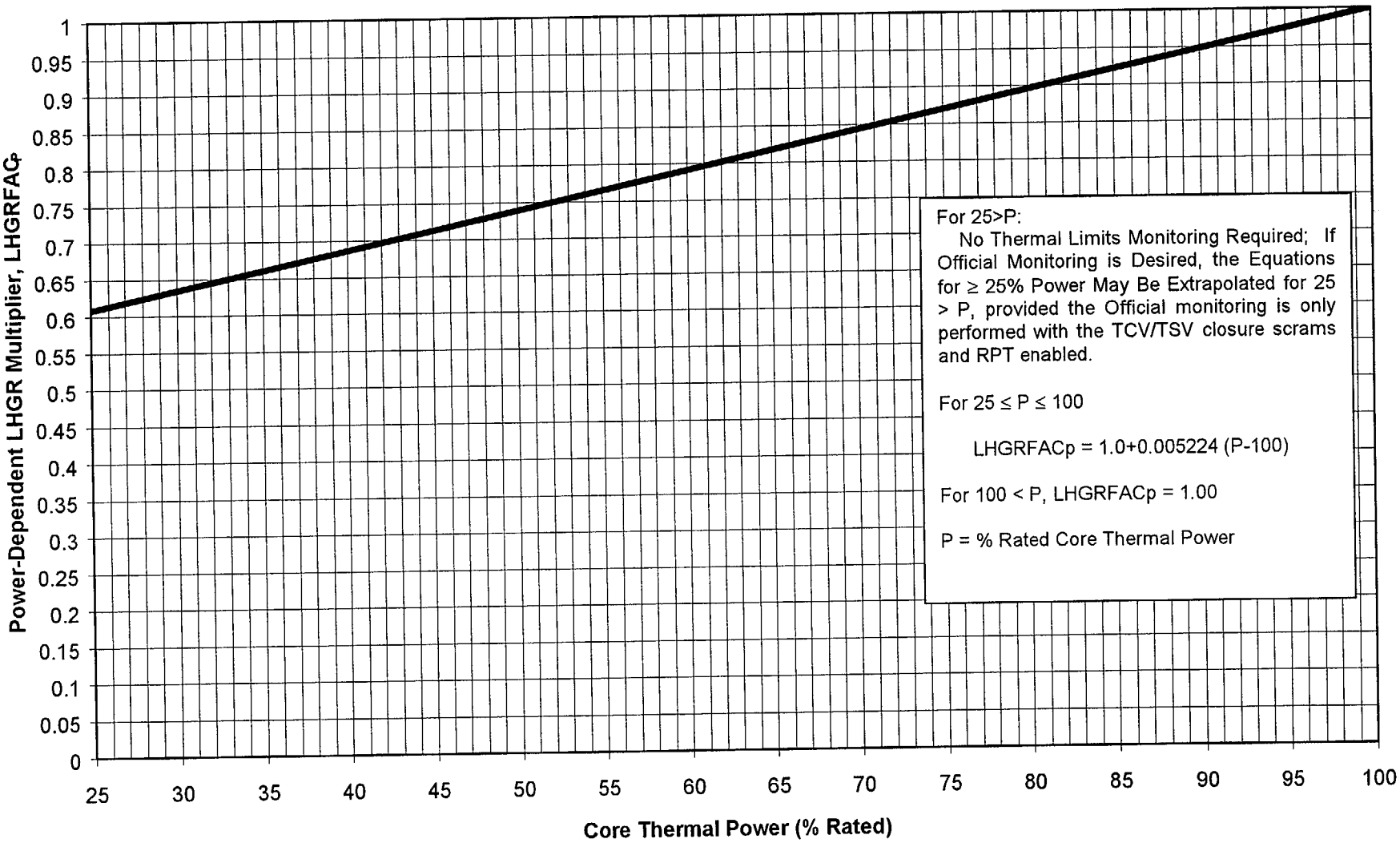


Figure 3.2-2 Power-Dependent LHGR Multiplier for GE Fuel (TCV(s) Slow Closure) (formerly $MAPFAC_P$)

(Reference 15 and 24)

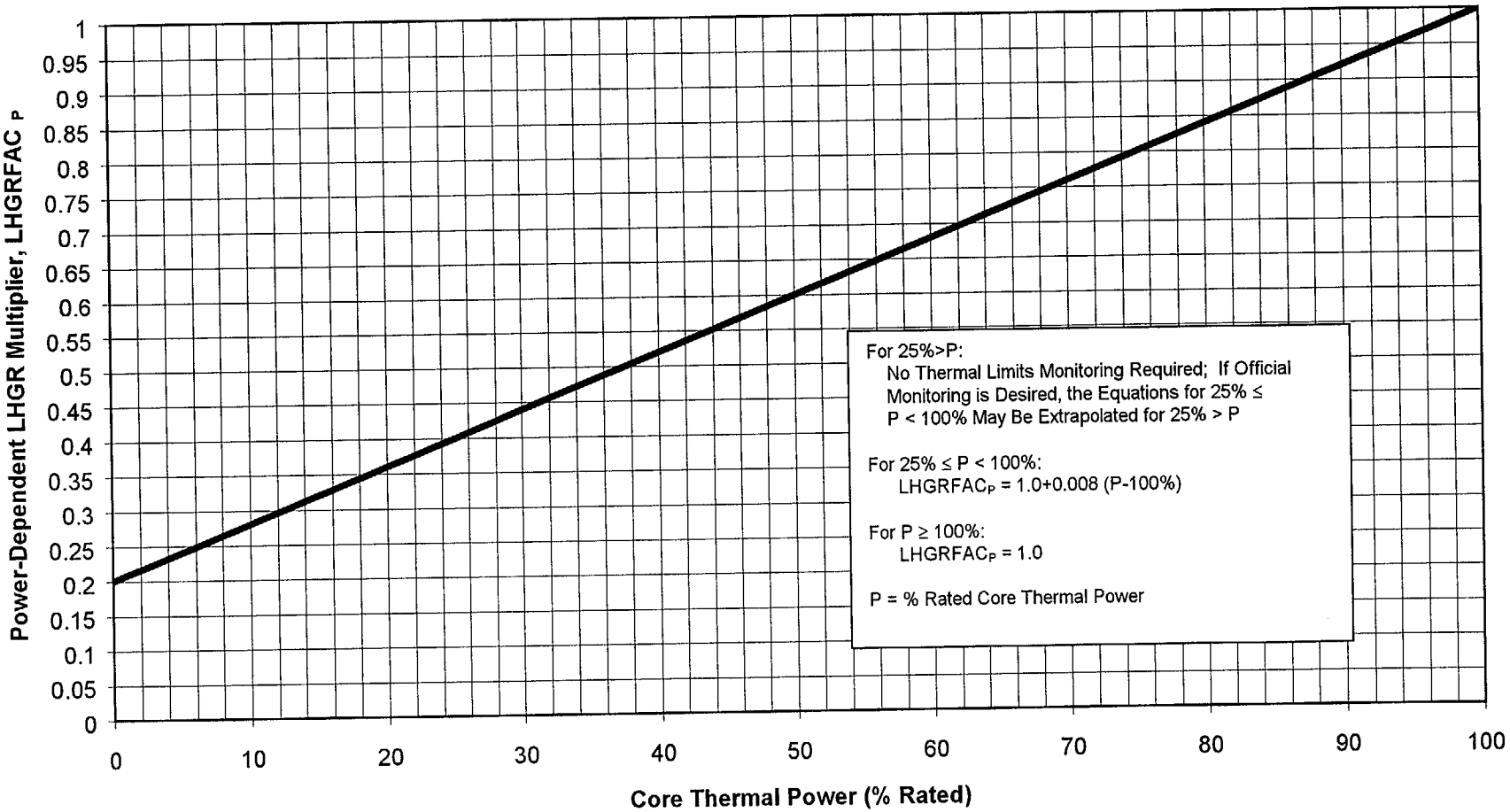


Figure 3.2-3 Flow-Dependent LHGR Multiplier for GE Fuel (formerly $MAPFAC_F$)

(Reference 9 and 17, 22, and 24)

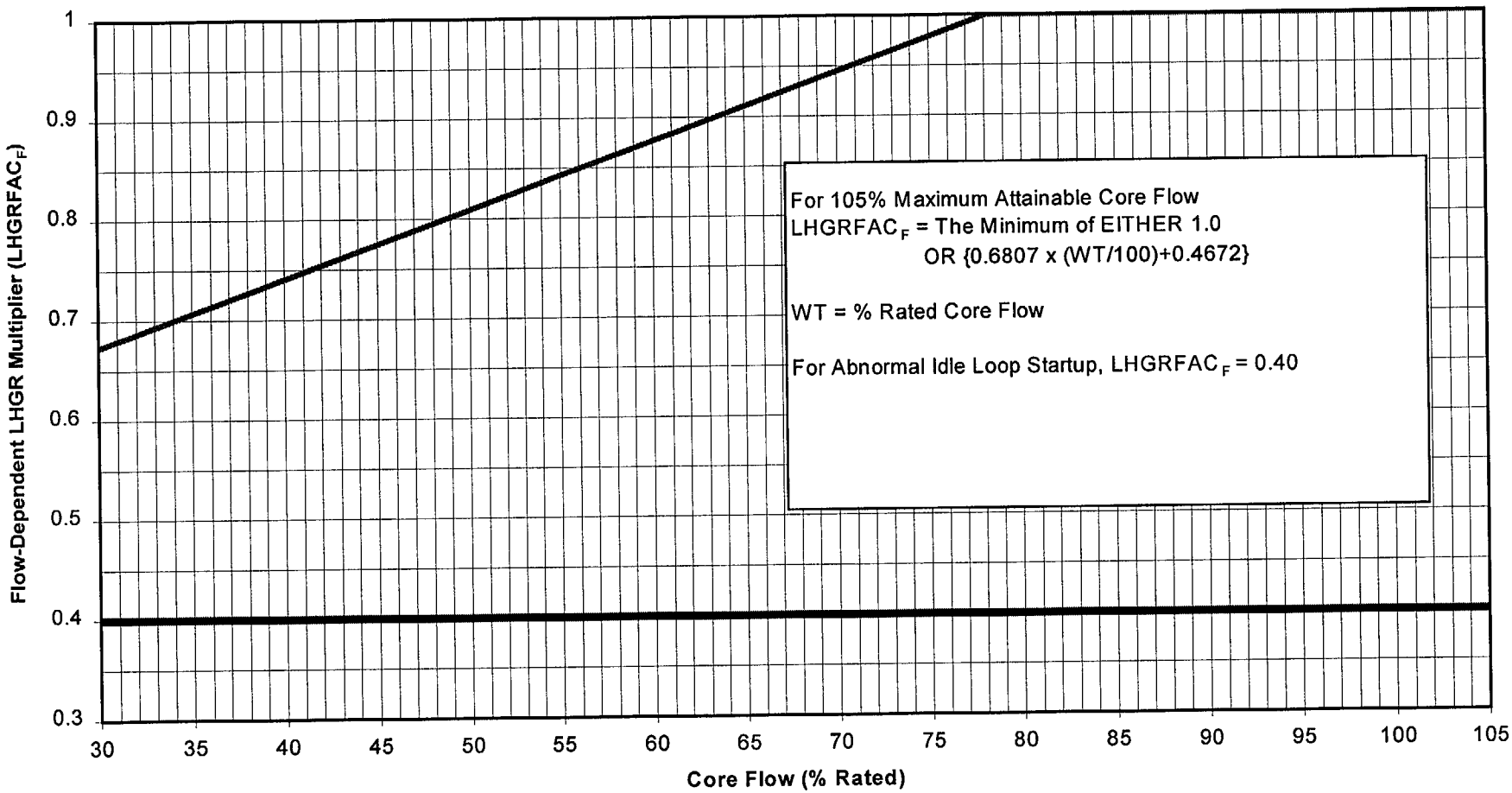


Table 3-1

LHGRFAC$_P$ for Siemens Fuel

(References 4, 5 and 54)

Operation from BOC to Coastdown**

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	0.67	0.67	0.67	0.94	0.98		1.00
Single RR Loop only	0.67	0.67	0.67	0.94	0.98		1.00
EOOS***	0.64	0.64	0.64		0.86	0.86	0.86
EOOS***/Single RR Loop	0.64	0.64	0.64		0.86	0.86	0.86

* Values are interpolated between relevant power levels. For operation at exactly 25% or 80% CTP, the more limiting value is used.
** Coastdown thermal limits are not provided in this COLR.
*** Allowable EOOS conditions are listed in Section 5.

Table 3-2

$LHGRFAC_F$ for Siemens Fuel

(References 4 & 5)

Values Applicable for up to 105% Maximum Attainable Core Flow

Flow (% rated)	LHGRFACf ATRIUM-9B
0	0.69
30	0.69
76	1.00
105	1.00

These $LHGRFAC_f$ multipliers apply from BOC through coastdown and in all EOOS scenarios.

4. Control Rod Withdrawal Block Instrumentation (3.3.2.1)

4.1 Tech Spec Reference:

Tech Spec Table 3.3.2.1-1.

4.2 Description:

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below:

ROD BLOCK MONITOR UPSCALE TRIP FUNCTION	TRIP SETPOINT	ALLOWABLE VALUE
Two Recirculation Loop Operation*	0.66 W + 51%**	0.66 W + 54%**
Single Recirculation Loop Operation*	0.66 W + 45.7%**	0.66 W + 48.7%**

* This setpoint may be lower/higher and will still comply with the RWE Analysis, because RWE is analyzed unblocked.

** Clamped, with an allowable value not to exceed the allowable value for recirculation loop flow (W) of 100%.

5. Allowed Modes of Operation (B 3.2.2, B 3.2.3)

The Allowed Modes of Operation with combinations of Equipment Out-of-Service are as described below:

Equipment Out of Service Options[1]	---------OPERATING REGION--------- Standard	MELLLA	ICF[7]	Coastdown[9]
None	Yes	Yes	Yes	No
Feedwater Heaters[2] (Reference 9)	Yes	No[3]	Yes	No
Single RR Loop[10] (Reference 9)	Yes	No[8]	N/A	No
Turbine Bypass Valves (Reference 9)	Yes	Yes	Yes	No
EOC Recirculation Pump Trip (Reference 9)	Yes	Yes	Yes	No
TCV Slow Closure/EOC Recirculation Pump Trip (Reference 15)	Yes	Yes	Yes	No
TCV Slow Closure/EOC Recirculation Pump Trip / Feedwater Heaters [2] (Reference 15, 20 and 21)	Yes	No[3]	Yes	No
Turbine Bypass Valves / Feedwater Heaters [2] (Reference 9)	No	No	No[5]	No
EOC Recirculation Pump Trip / Feedwater Heaters [2] (Reference 9)	Yes[4]	No[3]	Yes[4]	No
TCV Stuck Closed[6] (Reference 16)	Yes	Yes	Yes	No

1. Each EOOS condition may be combined with one SRV OOS, up to two TIP Machines OOS or the equivalent number of TIP channels (100% available at startup from a refuel outage), a 20°F reduction in feedwater temperature (without Feedwater Heaters considered OOS), cycle startup with uncalibrated LPRMs (BOC to 500 MWd/MTU), and/or up to 50% of the LPRMs out of service.
2. Up to 100°F Reduction in Feedwater Temperature Allowed with Feedwater Heaters Out-of-Service. Feedwater Heaters OOS may be an actual OOS condition, or an intentionally entered mode of operation to extend the cycle energy.
3. If operating with Feedwater Heaters Out-of-Service, operation in MELLLA is supported by current transient analyses, but administratively prohibited due to core stability concerns.
4. EOC Recirculation Pump Trip OOS/Feedwater Heaters OOS is allowed during non-coastdown operation using the TCV Slow Closure/EOC Recirculation Pump Trip OOS/Feedwater Heaters OOS operating limits.
5. Only when operating in coastdown, otherwise this combination is not allowed.
6. Operation is only allowed when less than 10.5 million lbm/hr steam flow and when average position of 3 open TCVs is less than 50% open, with FCL <103%, and the MCFL setpoint ≥ 120%. TCV Stuck Closed may be in combination with any EOOS except TBVOOS or TCV Slow Closure. If in combination with other EOOS(s), thermal limits may require adjustment for the other EOOS(s) as designated in Sections 1, 2, and 3.
7. ICF is analyzed for up to 105% core flow.
8. The SLO boundary was not moved up with the incorporation of MELLLA. The flow boundary for SLO at uprated conditions remains the ELLLA boundary for pre-uprate conditions. (Reference 25)
9. Coastdown is defined to begin at a core average exposure of 29,439 MWd/MTU (which is the licensing basis exposure used by SPC). (Reference 4).
10. Single Loop Operation is allowed with any of the EOOS options listed in this table.

6. Traversing In-Core Probe System (3.2.1, 3.2.2, 3.2.3)

6.1 Tech Spec Reference:

Tech Spec Sections 3.2.1, 3.2.2, 3.2.3 for thermal limits require the TIP system for recalibration of the LPRM detectors and monitoring thermal limits.

6.2 Description:

When the traversing in-core probe (TIP) system (for the required measurement locations) is used for recalibration of the LPRM detectors and monitoring thermal limits, the TIP system shall be operable with the following:

1. movable detectors, drives and readout equipment to map the core in the required measurement locations, and

2. indexing equipment to allow all required detectors to be calibrated in a common location.

For BOC to BOC + 500 MWD/MT, cycle analyses support thermal limit monitoring without the use of the TIPs.

Following the first TIP set (required prior to BOC + 500 MWD/MT), the following applies for use of the SUBTIP methodology:

With one or more TIP measurement locations inoperable, the TIP data for an inoperable measurement location may be replaced by data obtained from a 3-dimensional BWR core monitoring software system adjusted using the previously calculated uncertainties, provided the following conditions are met:

1. All TIP traces have previously been obtained at least once in the current operating cycle when the reactor core was operating above 20% power, (References 18, 52 and 53) and

2. The total number of simulated channels (measurement locations) does not exceed 42% (18 channels).

Otherwise, with the TIP system inoperable, suspend use of the system for the above applicable monitoring or calibration functions.

6.3 Bases:

The operability of the TIP system with the above specified minimum complement of equipment ensures that the measurements obtained from use of this equipment accurately represent the spatial neutron flux distribution of the reactor core. The normalization of the required detectors is performed internal to the core monitoring software system.

Substitute TIP data, if needed, is 3-dimensional BWR core monitoring software calculated data which is adjusted based on axial and radial factors calculated from previous TIP sets. Since uncertainty could be introduced by the simulation and adjustment process, a maximum of 18 channels may be simulated to ensure that the uncertainties assumed in the substitution process methodology remain valid.

Section 2

LaSalle Unit 1 Cycle 9

Reload Transient Analysis Results

May 2001

Technical Requirements Manual - Appendix I
L1C9 Reload Transient Analysis Results

Table of Contents

Attachment 1

LaSalle Unit 1 Cycle 9

Neutronics Licensing Report

NUCLEAR FUEL MANAGEMENT DEPARTMENT
NUCLEAR DESIGN INFORMATION TRANSMITTAL

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) _____	NDIT No. NFM9900149 Seq. No. 00 Page 1 of 27

Station LaSalle Unit 1 Cycle 9 Generic _____

To: Deborah A. Laughton

Subject LaSalle 1 Cycle 9 Neutronics Licensing Report (NLR)

Theodore P. Shannon Preparer	Preparer's Signature	10/7/99 Date
John K. Wheeler Reviewer	Reviewer's Signature	10/7/99 Date
Adelmo S. Pallotta NFM Supervisor	NFM Supervisor's Signature	10/8/99 Date

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified NDITs: _____

Description of Information: Results and bases of neutronics licensings calculations for LaSalle 1 Cycle 9. These calculations cover operation with a rated core power up to 3489 MWt.

Purpose of Information: Provide LaSalle County Station and NFM BSS group with neutronics licensing results.

Source of Information: NFM Calculation Note BNDL:99-050, Revision 0.

Supplemental Distribution: E.A. McVey (LaSalle), Jeff Nugent (LaSalle), Norha Plumey (LaSalle), Adelmo S. Pallotta, Robert W. Tsai, Randall H. Jacobs, LaSalle Central File, DG Central File

Licensing Basis

This document, in conjunction with References 1, 3 and 4 in Section VIII, provides the licensing basis for LaSalle County Station Unit 1 Reload 8, Cycle 9.

Table of Contents

JKW 10/7/99 10/7/99

I. Nuclear Design

I.1 New Reload Fuel Assembly Nuclear Design

I.1.1 Assembly Average Enrichment

Assembly Name	Batch Identifier	Enrichment (w/o U-235)
SPCA9-393B-16GZ-100M	19A	3.93
SPCA9-396B-12GZB-100M	19B	3.96
SPCA9-396B-12GZC-100M	19C	3.96
SPCA9-384B-11GZ6-80M	28B	3.84

I.1.2 Axial Enrichment and Burnable Poison Distribution

Assembly Name	Batch Identifier	Figure
SPCA9-393B-16GZ-100M	19A	1
SPCA9-396B-12GZB-100M	19B	1
SPCA9-396B-12GZC-100M	19C	1
SPCA9-384B-11GZ6-80M	28B	2

I.1.3 Radial Enrichment and Burnable Poison Distribution

Lattice Name	Batch Found In	Figure
SPCA9-4.56L-12G8.0/4G3.0-100M	19A	3
SPCA9-4.56L-12G8.0-100M	19A	4
SPCA9-3.91L-12G8.0-100M	19A	5
SPCA9-3.90L-8G5.0-100M	19A	6
SPCA9-4.59L-12G8.0-100M	19B	7
SPCA9-4.59L-12G7.0-100M	19B	8
SPCA9-3.96L-8G7.0/4G8.0-100M	19B	9
SPCA9-3.96L-8G5.0-100M	19B and 19C	10
SPCA9-4.58L-8G6.0/4G3.0-100M	19C	11
SPCA9-4.58L-8G6.0-100M	19C	12
SPCA9-4.06L-11G6.0-80M	28B	13
SPCA9-4.34L-10G6.0-80M	28B	14

10/6/99
JKW 10/6/99

I.2 Core Nuclear Design

I.2.1 Core Configuration and Licensing Exposure Limits

Assembly Name	Cycle Loaded	Number in Core
GE9B-P8CWB322-11GZ-100M-150-CECO	7	56
GE9B-P8CWB320-9GZ-100M-150-CECO	7	89
GE9B-P8CWB343-12GZ-80M-150-CECO	8	104
GE9B-P8CWB342-10GZ-80M-150-CECO	8	143
SPCA9-384B-11GZ6-80M	9	36
SPCA9-393B-16GZ-100M	9	208
SPCA9-396B-12GZB-100M	9	88
SPCA9-396B-12GZC-100M	9	40

	Core Average Exposure	Core Incremental Exposure
Exposure at EOC 8 (Cycle N-1)		
Nominal EOC 8 (MWD/MT)	27966.9	12511.0
Short EOC 8 (MWD/MT) [for shutdown consideration]	27455.9	12000.0

Cycle 9 (Cycle N) neutronics analyses are valid for EOC 8 (Cycle N-1) exposures greater than 12000 MWD/MT. The exposure window that validates the pressurization transients can be found in the L1C9 reload analysis document (Reference 3).

	Core Average Exposure
Exposure at BOC 9 (Cycle N)	
With Nominal EOC 8 (MWD/MT)	10961.0
With Short EOC 8 (MWD/MT)	10634.9

The Cycle 9 incremental exposure to LFPC is 18000.0 MWD/MT (incremental energy to LFPC of 2418.0 GWD) based on a nominal EOC 8.

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I.2.2 Core Reactivity Characteristics

All values reported below are with zero xenon and are for 68°F moderator temperature. The MICROBURN-B cold BOC K-effective bias is 1.0050 (Reference 11). The shutdown margin calculations are based on the short cycle 8 exposure given in Section I.2.1.

BOC Cold K-Effective, All Rods Out	1.11710
BOC Cold K-Effective, All Rods In	0.96354
BOC Cold K-Effective, Strongest Rod Out	0.99407
BOC Shutdown Margin, % ΔK	1.09
Minimum Shutdown Margin, % ΔK	1.01
Cycle Exposure(s) of Minimum Shutdown Margin, MWD/MT	250.0 & 15000.0
Reactivity Defect (R-value) Total, % ΔK	0.08
Standby Liquid Control System (SLCS) Shutdown Margin, Cold Condition, 660 ppm enriched Boron, % ΔK	17.81

Note that the SLCS analysis results credit a B-10 enrichment of 45% at LaSalle.

II. Control Rod Withdrawal Error

Analysis was performed at a core power of 3489 MWt, 100% core flow (108.5 Mlbm/hr), unblocked (RBM not credited) conditions only. Figure 15 is the initial rod pattern for the case that set the limit for the ATRIUM-9B fuel in the core. Figure 16 is initial rod pattern for the case that set the limit for the GE9B fuel in the core. These results bound operation with 3323 MWt as the rated power for the core.

Distance Withdrawn (ft)	ATRIUM-9B ΔCPR	GE9B ΔCPR
12	0.29	0.31

The design complies with the SPC 1% plastic strain criteria via conformance to the PAPT (Protection Against Power Transient) LHGR limits. The design complies with the GE centerline melt criteria via conformance to the GE thermal overpower protection (TOP) criteria. The design complies with the GE 1% plastic strain criteria via conformance to updated GE mechanical overpower protection (MOP) criteria during a control rod withdrawal error event.

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III. Fuel Loading Error

The fuel loading error, including fuel mislocation and misorientation, is classified as an accident. By demonstrating that the fuel loading error meets the more stringent Anticipated Operational Occurrence (AOO) requirements, the offsite dose requirement is assured to be met. Because the events listed below result in a ΔCPR value that is less than that of the limiting transient, the AOO requirements and hence the off-site dose requirements are met for the fuel loading error.

The values reported below bound all fuel types found in the core.

Event	ΔCPR
Mislocated Bundle	0.31
Misoriented Bundle	0.17

The design complies with the SPC 1% plastic strain and centerline melt criteria via conformance to the PAPT (Protection Against Power Transient) LHGR limits.

IV. Control Rod Drop Accident

LaSalle is a Banked Position Withdrawal Sequence (BPWS) plant. In order to allow the site the option of shutting down the reactor by inserting control rods using the simplified control rod sequences shown in Table 1, the control rod drop accident analysis was performed for the simplified sequence. The results from this simplified sequence analysis bound those where BPWS guidelines are followed. The results demonstrate that the 280 cal/g Technical Specification limit for a control rod drop accident is not exceeded. Note that the 0.32%Δk adder mentioned below is included in this analysis to account for possible rod mispositioning errors as well as clumping effects.

Dropped Control Rod Worth without 0.32 %Δk adder, %Δk	0.722
Dropped Control Rod Worth with 0.32 %Δk adder, %Δk	1.042
Doppler Coefficient used, (Δk/k)/°F	-9.50E-06
Effective Delayed Neutron Fraction used	0.0052
Four-Bundle Local Peaking Factor	1.358
Maximum Deposited Fuel Rod Enthalpy with 0.32 %Δk adder, (cal/gm)	184.1
Number of Rods Greater than 170 cal/gm with 0.32%Δk adder	134

Note that the limit on maximum deposited fuel rod enthalpy is 280 cal/gm and the (conservative) limit on the number of rods greater that 170 cal/gm (failed rods) is 770 .

10/6/99
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V. Loss of Feedwater Heating

The loss of feedwater heating event is analyzed at a core power of 3489 MWt for 81%, 100% and 105% rated flow with an assumed inlet temperature decrease of 145°F. These results bound operation with 3323 MWt as the rated power for the core.

Event	ATRIUM-9B ΔCPR	GE9B ΔCPR
Loss of Feedwater Heating	0.19	0.18

The design complies with the SPC 1% plastic strain and centerline melt criteria via conformance to the PAPT (Protection Against Power Transient) LHGR limits. The design complies with the GE 1% plastic strain criteria via conformance to the mechanical overpower protection (MOP) limit. The design complies with the GE centerline melt criteria via conformance to the thermal overpower protection (TOP) limits. The analyses did not take credit for the thermal power scram function at the site.

VI. Maximum Exposure Limit Compliance

Note that the exposures listed below are based on the nominal Cycle 8 (Cycle N-1) exposure, 12511 MWD/MT, and the licensing basis (Reference 3) Cycle 9 (Cycle N) core average exposure of 29439 MWD/MT.

Exposure Criteria	GE9B Projected Exposure (GWD/MT)	GE9B Exposure Limit (GWD/MT)	ATRIUM-9B Projected Exposure (GWD/MT)	ATRIUM-9B Exposure Limit* (GWD/MT)
Peak Fuel Assembly	44.9	48.0**	23.8	48.0
Peak Fuel Batch	40.4	42.0	N/A	N/A
Peak Fuel Rod	N/A	N/A	26.4	55.0
Peak Fuel Pellet	58.4	60.0	35.6	66.0

* The ATRIUM-9B exposure limits identified are not applicable until document EMF-85-74 is added to the Technical Specifications (Tech Specs). Until this document is added to the Tech Specs, the ATRIUM-9B exposure limits are 48.0 GWD/MT for Peak Fuel Assembly (no change), 50.0 GWD/MT for Peak Fuel Rod and 60.0 GWD/MT for Peak Fuel Pellet.

** There is no peak fuel assembly exposure limit for GE9B fuel. The limit reported above is based on the maximum channel exposure assumption used in developing the safety limit MCPR for LaSalle 1 Cycle 9.

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VII. Spent Fuel Pool and Fresh Fuel Vault Criticality Compliance

For the L1C9 reload, there are three new SPC ATRIUM-9B assembly types consisting of 10 unique enriched lattices as well as one SPC ATRIUM-9B assembly type with 2 unique enriched lattices which was initially manufactured for use in L2C8. These four (total) assembly and twelve (total) enriched lattice types are identified in **I.1 New Reload Fuel Assembly Nuclear Design.** For the purpose of the following sections all four assembly types will be referred to as "new (ATRIUM-9B) assemblies".

VII.1 Fresh Fuel Vault Criticality Compliance

The fuel storage vault criticality analysis that is detailed in Reference 6 remains valid for the above lattices. All the new (ATRIUM-9B) assemblies comply with the fresh fuel vault criticality limits, i.e., all lattices have an enrichment of less than 5.00 wt % U-235 and a gadolinia content that is greater than 6 rods at 3.0 wt% Gd_2O_3.

VII.2 L1 Spent Fuel Pool Criticality Compliance

The LaSalle Unit 1 spent fuel pool criticality analysis that is detailed in Reference 7 remains valid for the above lattices. All the new (ATRIUM-9B) assemblies comply with the spent fuel pool criticality limits, i.e., all lattices have an enrichment of less than 4.60 wt % U-235 and a gadolinia content that is greater than 8 rods at 3.0 wt% Gd_2O_3.

VII.3 L2 Spent Fuel Pool Criticality Compliance

The LaSalle Unit 2 spent fuel pool criticality analysis that is detailed in Reference 8 remains valid for the above lattices. As shown below, all the new (ATRIUM-9B) assemblies comply with the LaSalle Unit 2 spent fuel pool criticality limit of k-eff < 0.95.

Lattice Type	Maximum k-inf*	Maximum in-Rack k-eff**	Spent Fuel Pool k-eff Limit
SPCA9-4.56L-12G8.0/4G3.0-100M	1.182	< 0.85	0.95
SPCA9-4.56L-12G8.0-100M	1.187	< 0.85	0.95
SPCA9-3.91L-12G8.0-100M	1.168	< 0.85	0.95
SPCA9-3.90L-8G5.0-100M	1.233	< 0.86	0.95
SPCA9-4.59L-12G8.0-100M	1.191	< 0.85	0.95
SPCA9-4.59L-12G7.0-100M	1.210	< 0.85	0.95
SPCA9-3.96L-8G7.0/4G8.0-100M	1.186	< 0.85	0.95
SPCA9-3.96L-8G5.0-100M	1.231	< 0.86	0.95
SPCA9-4.58L-8G6.0/4G3.0-100M	1.233	< 0.86	0.95
SPCA9-4.58L-8G6.0-100M	1.236	< 0.86	0.95
SPCA9-4.06L-11G6.0-80M	1.213	< 0.85	0.95
SPCA9-4.34L-10G6.0-80M	1.227	< 0.86	0.95

* From 68 °F, uncontrolled CASMO-3G results.
** From Figure 6.1 of Reference 8.

10/7/99
JKW 10/7/99

VIII. References

1. Commonwealth Edison Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", Revision 0, Supplements 1 and 2, December 1991, March 1992, and May 1992, respectively; SER letter dated March 22, 1993.

2. "LaSalle 1 Cycle 9 Core Design", NDIT NFM9900038, Sequence 02, September 23, 1999.

3. "LaSalle Unit 1 Cycle 9 Reload Analysis", Siemens Power Corporation, EMF-2276.

4. "LaSalle Unit 1 Cycle 9 Plant Transient Analysis", Siemens Power Corporation, EMF-2277.

5. "Fuel Design Report for LaSalle Unit 1 Cycle 9 ATRIUM™-9B Fuel Assemblies", Siemens Power Corporation, EMF-2249(P), Revision 1, September 1999.

6. "Criticality Safety Analysis for ATRIUM-9B Fuel, LaSalle Units 1 and 2 New Fuel Storage Vault", Siemens Power Corporation, EMF-95-134(P), December 1995. [NDIT 960089, Revision 0 (sic).]

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VIII. References

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Table 1

LaSalle 1 Cycle 9 Simplified Shutdown Sequences

Shutdown From an A1 Sequence

Rod Group	Insertion (Bank)	Comments*
7 or 8	48-00	Either Group 7 or 8 may be inserted first.
10	48-10	Groups 7 and 8 must be fully inserted prior to inserting any Group 10 rod.
10	10-00	Group 10 must be at 10 prior to inserting any Group 10 rod to 00.
9	48-10	Group 10 must be fully inserted prior to inserting any Group 9 rod.
9	10-00	Group 9 must be at 10 prior to inserting any Group 9 rod to 00.
5 or 6	48-00	Groups 5 and 6 may be inserted without banking anytime after Groups 7 and 8 have been inserted and before Group 4 is inserted.
4	48-00	Groups 5 through 10 must be fully inserted prior to inserting any Group 4 rod.
3	48-10	Group 4 must be fully inserted prior to inserting any Group 3 rod.
3	10-00	Group 3 must be at 10 prior to inserting any Group 3 rod to 00.
2	48-00	Group 3 must be fully inserted prior to inserting any Group 2 rod.
1	48-00	Group 2 must be fully inserted prior to inserting any Group 1 rod.

Shutdown from an A2 Sequence

Rod Group	Insertion (Bank)	Comments*
9 or 10	48-00	Either Group 9 or 10 may be inserted first.
8	48-00	Groups 9 and 10 must be fully inserted prior to inserting any Group 8 rod.
7	48-10	Group 8 must be fully inserted prior to inserting any Group 7 rod.
7	10-00	Group 7 must be at 10 prior to inserting any Group 7 rod to 00.
5 or 6	48-00	Groups 5 and 6 may be inserted without banking anytime after Groups 9 and 10 have been inserted and before Group 4 is inserted.
4	48-00	Groups 5 through 10 must be fully inserted prior to inserting any Group 4 rod.
3	48-10	Group 4 must be fully inserted prior to inserting any Group 3 rod.
3	10-00	Group 3 must be at 10 prior to inserting any Group 3 rod to 00.
2	48-00	Group 3 must be fully inserted prior to inserting any Group 2 rod.
1	48-00	Group 2 must be fully inserted prior to inserting any Group 1 rod.

* The standard BPWS rules concerning out-of-service rods apply to the shutdown sequences.

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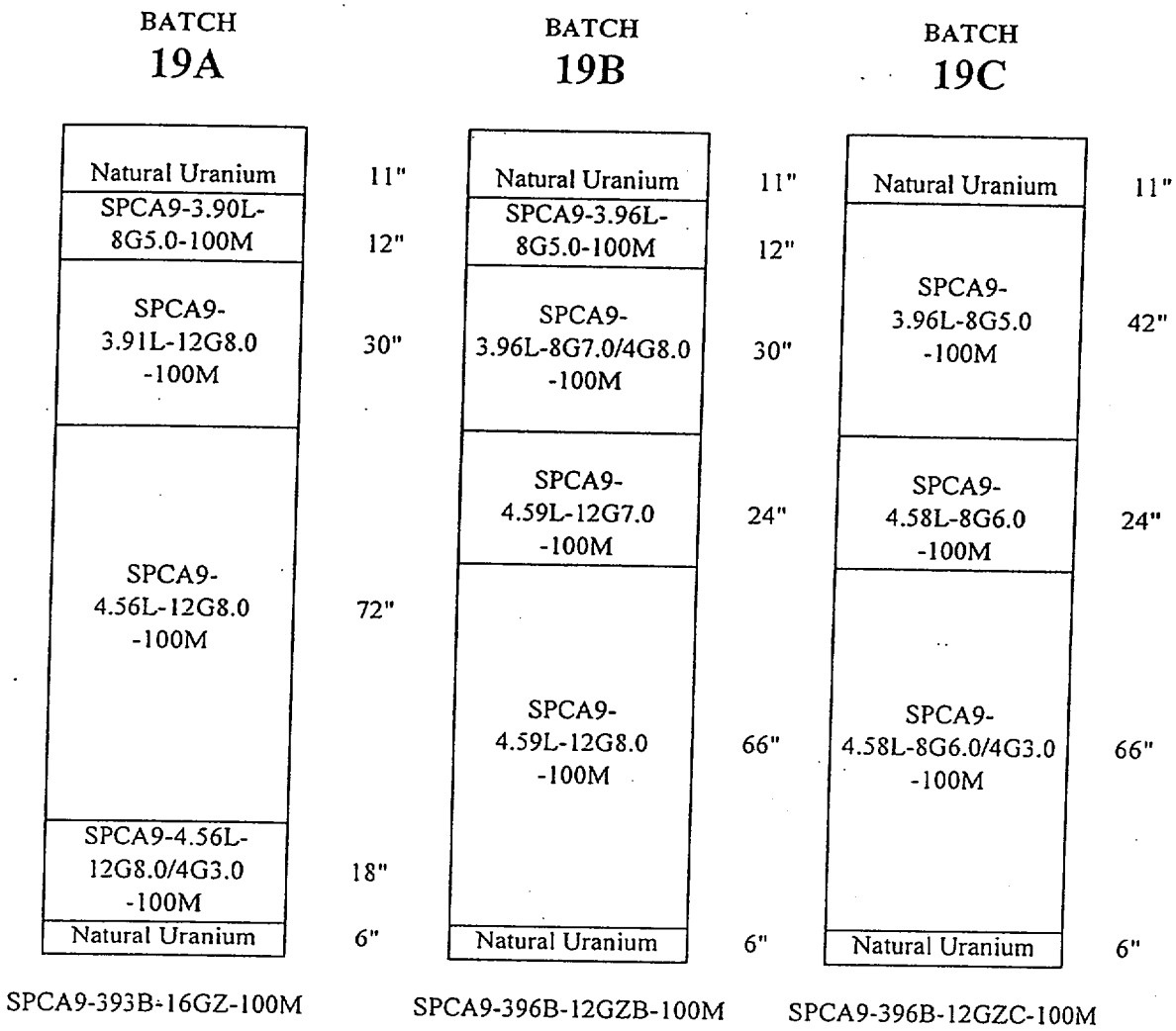

Figure 1

L1C9 ATRIUM-9B Assembly Axial Designs (100M Channels)

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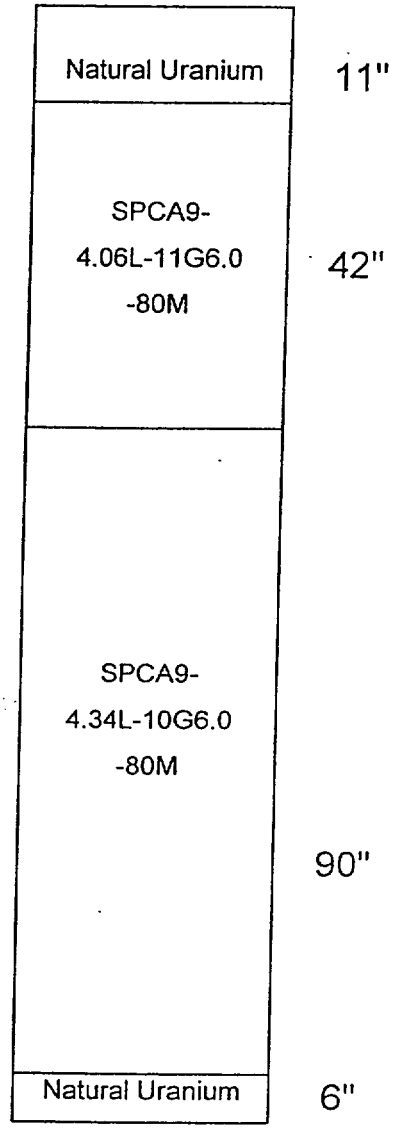
BATCH

28B



SPCA9-384B-11GZ6-80M

Figure 2

L1C9 ATRIUM-9B Assembly Axial Designs (80M Channels)

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1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	G3 4.00	G2 4.20	4 4.95	G1 4.70	4 4.95	G2 4.20	G3 4.00	2 4.00
3 4.70	G2 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G2 4.20	3 4.70
4 4.95	4 4.95	4 4.95	Internal Water Channel			4 4.95	4 4.95	4 4.95
4 4.95	G1 4.70	4 4.95				4 4.95	G1 4.70	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
3 4.70	G2 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G2 4.20	3 4.70
2 4.00	G3 4.00	G2 4.20	4 4.95	G1 4.70	4 4.95	G2 4.20	G3 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (8)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (36)	4.95 w/o U-235
G1	Rods (4)	4.70 w/o U-235+8.0 w/o Gd2O3
G2	Rods (8)	4.20 w/o U-235+8.0 w/o Gd2O3
G3	Rods (4)	4.00 w/o U-235+3.0 w/o Gd2O3

Figure 3
SPCA9-4.56L-12G8.0/4G3.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	2 4.00	G2 4.20	4 4.95	G1 4.70	4 4.95	G2 4.20	2 4.00	2 4.00
3 4.70	G2 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G2 4.20	3 4.70
4 4.95	4 4.95	4 4.95	Internal Water Channel			4 4.95	4 4.95	4 4.95
4 4.95	G1 4.70	4 4.95				4 4.95	G1 4.70	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
3 4.70	G2 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G2 4.20	3 4.70
2 4.00	2 4.00	G2 4.20	4 4.95	G1 4.70	4 4.95	G2 4.20	2 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (12)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (36)	4.95 w/o U-235
G1	Rods (4)	4.70 w/o U-235+8.0 w/o Gd2O3
G2	Rods (8)	4.20 w/o U-235+8.0 w/o Gd2O3

Figure 4
SPCA9-4.56L-12G8.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60
2 3.40	2 3.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	2 3.40	2 3.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
4 4.40	4 4.40	4 4.40	Internal Water Channel			4 4.40	4 4.40	4 4.40
4 4.40	G1 3.40	4 4.40				4 4.40	G1 3.40	4 4.40
4 4.40	4 4.40	4 4.40				4 4.40	4 4.40	4 4.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
2 3.40	2 3.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	2 3.40	2 3.40
1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60

1	Rods (4)	2.60 w/o U-235
2	Rods (12)	3.40 w/o U-235
3	Rods (8)	3.80 w/o U-235
4	Rods (36)	4.40 w/o U-235
G1	Rods (12)	3.40 w/o U-235+8.0 w/o Gd2O3

Figure 5
SPCA9-3.91L-12G8.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60
2 3.40	2 3.40	G1 3.40	4 4.40	2 3.40	4 4.40	G1 3.40	2 3.40	2 3.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
4 4.40	4 4.40	4 4.40	Internal Water Channel			4 4.40	4 4.40	4 4.40
4 4.40	2 3.40	4 4.40				4 4.40	2 3.40	4 4.40
4 4.40	4 4.40	4 4.40				4 4.40	4 4.40	4 4.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
2 3.40	2 3.40	G1 3.40	4 4.40	2 3.40	4 4.40	G1 3.40	2 3.40	2 3.40
1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60

1	Rods (4)	2.60 w/o U-235
2	Rods (16)	3.40 w/o U-235
3	Rods (8)	3.80 w/o U-235
4	Rods (36)	4.40 w/o U-235
G1	Rods (8)	3.40 w/o U-235+5.0 w/o Gd_2O_3

Figure 6
SPCA9-3.90L-8G5.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	2 4.00
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
4 4.95	G1 4.20	4 4.95	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
2 4.00	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (8)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (40)	4.95 w/o U-235
G1	Rods (12)	4.20 w/o U-235+8.0 w/o Gd_2O_3

Figure 7
SPCA9-4.59L-12G8.0-100M (19B)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	2 4.00
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
4 4.95	G1 4.20	4 4.95	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
2 4.00	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (8)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (40)	4.95 w/o U-235
G1	Rods (12)	4.20 w/o U-235+7.0 w/o Gd2O3

Figure 8
SPCA9-4.59L-12G7.0-100M (19B)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60
2 3.40	G2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G2 3.40	2 3.40
3 3.80	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	3 3.80
4 4.40	G1 3.40	4 4.40	Internal Water Channel			4 4.40	G1 3.40	4 4.40
4 4.40	4 4.40	4 4.40				4 4.40	4 4.40	4 4.40
4 4.40	G1 3.40	4 4.40				4 4.40	G1 3.40	4 4.40
3 3.80	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	3 3.80
2 3.40	G2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G2 3.40	2 3.40
1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60

1	Rods (4)	2.60 w/o U-235
2	Rods (8)	3.40 w/o U-235
3	Rods (8)	3.80 w/o U-235
4	Rods (40)	4.40 w/o U-235
G1	Rods (8)	3.40 w/o U-235+7.0 w/o Gd2O3
G2	Rods (4)	3.40 w/o U-235+8.0 w/o Gd2O3

Figure 9
SPCA9-3.96L-8G7.0/4G8.0-100M (19B)
Enrichment Distribution

TPS 8/20/99
JKW 10/6/99

1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60
2 3.40	2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	2 3.40	2 3.40
3 3.80	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	3 3.80
4 4.40	G1 3.40	4 4.40	Internal Water Channel			4 4.40	G1 3.40	4 4.40
4 4.40	4 4.40	4 4.40				4 4.40	4 4.40	4 4.40
4 4.40	G1 3.40	4 4.40				4 4.40	G1 3.40	4 4.40
3 3.80	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	3 3.80
2 3.40	2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	2 3.40	2 3.40
1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60

1	Rods (4)	2.60 w/o U-235
2	Rods (12)	3.40 w/o U-235
3	Rods (8)	3.80 w/o U-235
4	Rods (40)	4.40 w/o U-235
G1	Rods (8)	3.40 w/o U-235+5.0 w/o Gd2O3

Figure 10
SPCA9-3.96L-8G5.0-100M (19B and 19C)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	G2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G2 4.00	2 4.00
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
4 4.95	G1 4.20	4 4.95	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
2 4.00	G2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G2 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (8)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (40)	4.95 w/o U-235
G1	Rods (8)	4.20 w/o U-235+6.0 w/o Gd2O3
G2	Rods (4)	4.00 w/o U-235+3.0 w/o Gd2O3

Figure 11
SPCA9-4.58L-8G6.0/4G3.0-100M (19C)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	2 4.00	2 4.00
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
4 4.95	G1 4.20	4 4.95	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
2 4.00	2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	2 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (12)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (40)	4.95 w/o U-235
G1	Rods (8)	4.20 w/o U-235+6.0 w/o Gd2O3

Figure 12
SPCA9-4.58L-8G6.0-100M(19C)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 2.72	2 3.53	3 3.94	3 3.94	4 4.53	3 3.94	3 3.94	2 3.53	1 2.72
2 3.53	G 3.69	4 4.53	4 4.53	G 3.69	4 4.53	4 4.53	G 3.69	2 3.53
3 3.94	4 4.53	4 4.53	4 4.53	4 4.53	4 4.53	4 4.53	4 4.53	3 3.94
3 3.94	4 4.53	4 4.53	Internal Water Channel			G 3.69	4 4.53	3 3.94
4 4.53	G 3.69	4 4.53				4 4.53	G 3.69	4 4.53
3 3.94	4 4.53	4 4.53				4 4.53	4 4.53	3 3.94
3 3.94	4 4.53	4 4.53	G 3.69	4 4.53	4 4.53	G 3.69	4 4.53	3 3.94
2 3.53	G 3.69	4 4.53	4 4.53	G 3.69	4 4.53	4 4.53	G 3.69	2 3.53
1 2.72	2 3.53	3 3.94	3 3.94	4 4.53	3 3.94	3 3.94	2 3.53	1 2.72

1	Rods (4)	2.72 w/o U-235
2	Rods (8)	3.53 w/o U-235
3	Rods (16)	3.94 w/o U-235
4	Rods (33)	4.53 w/o U-235
G	Rods (11)	3.69 w/o U-235+6.0 w/o Gd2O3

Figure 13
SPCA9-4.06L-11G6.0-80M (28B)
Enrichment Distribution

8/22/99
JKW 10/6/99

1 2.72	2 3.78	3 4.19	3 4.19	4 4.78	3 4.19	3 4.19	2 3.78	1 2.72
2 3.78	G 4.19	4 4.78	4 4.78	G 4.19	4 4.78	4 4.78	G 4.19	2 3.78
3 4.19	4 4.78	4 4.78	4 4.78	4 4.78	4 4.78	4 4.78	4 4.78	3 4.19
3 4.19	4 4.78	4 4.78	Internal Water Channel			G 4.19	4 4.78	3 4.19
4 4.78	G 4.19	4 4.78				4 4.78	G 4.19	4 4.78
3 4.19	4 4.78	4 4.78				4 4.78	4 4.78	3 4.19
3 4.19	4 4.78	4 4.78	G 4.19	4 4.78	4 4.78	4 4.78	4 4.78	3 4.19
2 3.78	G 4.19	4 4.78	4 4.78	G 4.19	4 4.78	4 4.78	G 4.19	2 3.78
1 2.72	2 3.78	3 4.19	3 4.19	4 4.78	3 4.19	3 4.19	2 3.78	1 2.72

1	Rods (4)	2.72 w/o U-235
2	Rods (8)	3.78 w/o U-235
3	Rods (16)	4.19 w/o U-235
4	Rods (34)	4.78 w/o U-235
G	Rods (10)	4.19 w/o U-235+6.0 w/o Gd2O3

Figure 14
SPCA9-4.34L-10G6.0-80M (28B)
Enrichment Distribution

8/22/99
JKW 10/6/99

Cycle 9 Exposure 13000.0 MWd/MTU
1746.3 GWd
Core Average Exposure 23961.4 MWd/MTU

```
Delta E: MWd/MTU, (GWd)          .0 (    .00 )
Power: MWt                    3489.0 (100.00 %)
Core Pressure: psia           1020.1
Inlet Subcooling: Btu/lbm     -18.28
Flow: Mlb/hr                  108.50 (100.00 %)

    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
59              -- -- -- -- -- -- --              59
55           -- -- 16 -- -- -- 16 -- --           55
51        -- --  0 --  0 --  0 --  0 -- --        51
47     -- -- 16 -- -- -- -- -- -- -- 16 -- --     47
43 -- --  0 --  8 --  0 --  0 --  8 --  0 -- -- 43
39 -- 16 -- -- -- -- -- -- -- -- -- -- -- 16 -- 39
35 -- --  0 --  0 -- 16 -- 16 --  0 --  0 -- -- 35
31 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 31
27 -- --  0 --  0 -- 16 -- 16 --  0 --  0 -- -- 27
23 -- 16 -- -- -- -- -- -- -- -- -- -- -- 16 -- 23
19 -- --  0 --  8 --  0 --  0 --  8 --  0 -- -- 19
15     -- -- 16 -- -- -- -- -- -- -- 16 -- --     15
11        -- --  0 --  0 --  0 --  0 -- --        11
 7           -- -- 16 -- -- -- 16 -- --           7
 3              -- -- -- -- -- -- --              3
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58

Control Rod Density: %        20.54

k-effective:                 1.00388
Void Fraction:                .448
Core Delta-P: psia           21.675
Core Plate Delta-P: psia     17.213
Coolant Temp: Deg-F           545.8
In Channel Flow: Mlb/hr       93.26
Source Convergence           .00008
```

Axial Profile

	N	Power	Exposure
Top	25	.153	3.961
	24	.284	6.830
	23	.663	16.284
	22	.806	19.848
	21	.874	21.821
	20	.935	23.364
	19	.978	24.366
	18	1.006	25.256
	17	1.010	26.344
	16	1.011	27.653
	15	1.013	28.409
	14	1.030	28.934
	13	1.056	29.323
	12	1.087	29.530
	11	1.128	29.908
	10	1.177	30.365
	9	1.231	30.778*
	8	1.279	30.556
	7	1.347	30.740
	6	1.421	30.648
	5	1.485*	29.817
	4	1.477	27.607
	3	1.308	23.608
	2	.962	17.267
Bottom	1	.279	4.864

% AXIAL TILT -18.447 -10.750
AVG BOT 8ft/12ft 1.1042 1.0860

Active Channel Flow: Mlb/hr 93.26

Figure 15
Initial RWE Rod Pattern for Limiting ATRIUM-9B Case
Error Rod is 34-43

8/22/99
JLW 10/6/99

Cycle 9 Exposure .0 MWd/MTU

.0 GWd

Core Average Exposure 10961.0 MWd/MTU

Delta E: MWd/MTU, (GWd)	.0 (.00)	
Power: MWt	3489.0	(100.00 %)
Core Pressure: psia	1020.1	
Inlet Subcooling: Btu/lbm	-18.28	
Flow: Mlb/hr	108.50	(100.00 %)

```
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
59              -- -- -- -- -- -- --              59
55           -- -- 20 --  0 -- 20 -- --           55
51        -- -- -- -- -- -- -- -- -- -- --        51
47     -- -- 12 --  0 -- 24 --  0 -- 12 -- --     47
43 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 43
39 -- 20 --  0 -- 24 --  0 -- 24 --  0 -- 20 -- 39
35 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 35
31 --  0 -- 24 --  0 -- 24 --  0 -- 24 --  0 -- 31
27 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 27
23 -- 20 --  0 -- 24 --  0 -- 24 --  0 -- 20 -- 23
19 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 19
15     -- -- 12 --  0 -- 24 --  0 -- 12 -- --     15
11        -- -- -- -- -- -- -- -- -- -- --        11
 7           -- -- 20 --  0 -- 20 -- --           7
 3              -- -- -- -- -- -- --              3
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
```

Control Rod Density: %	15.23
k-effective:	1.00250
Void Fraction:	.430
Core Delta-P: psia	21.559
Core Plate Delta-P: psia	17.096
Coolant Temp: Deg-F	545.5
In Channel Flow: Mlb/hr	93.36
Source Convergence	.00007

Axial Profile

	N	Power	Exposure
Top	25	.134	1.558
	24	.242	2.748
	23	.614	6.567
	22	.753	8.305
	21	.813	9.766
	20	.885	10.769
	19	.947	11.473
	18	1.008	12.074
	17	1.084	12.760
	16	1.209	13.155
	15	1.271	13.418
	14	1.290	13.606
	13	1.288	13.747
	12	1.256	13.859
	11	1.254	13.965
	10	1.273	14.034*
	9	1.304	14.008
	8	1.326	13.527
	7	1.357	13.424
	6	1.365*	13.358
	5	1.316	13.185
	4	1.164	12.622
	3	.968	11.120
	2	.693	8.223
Bottom	1	.187	2.308

% AXIAL TILT -13.547 -10.296

AVG BOT 8ft/12ft 1.1172 1.0898

Active Channel Flow: Mlb/hr 93.36

Figure 16
Initial RWE Rod Pattern for Limiting GE9B Case
Error Rod is 30-39

8/22/99
JKW 10/6/99