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

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

Subject: Unit 1 Cycle 10 Core Operating Limits Report (COLR)

Exelon Generation Company (EGC), LLC, in accordance with LaSalle County Station Technical Specifications (TS) Section 5.6.5, "Core Operating Limits Report," is submitting a revision to the Core Operating Limits Report (COLR). This COLR is being issued to identify the thermal limits governing LaSalle Unit 1 Cycle 10A operation. The Cycle 10A designation is used for unit operation following a mid-cycle outage to replace leaking fuel assemblies. Four leaking assemblies were identified and replaced with one reconstituted assembly and three recently discharged assemblies. These limits were developed using approved methodologies identified in the Technical Specifications.

Should you have any questions concerning this submittal, please contact Mr. Glen Kaegi, Regulatory Assurance Manager, at (815) 415-2800.

Respectfully,

Mark Schiavoni for

George P. Barnes
Site Vice President
LaSalle County Station

Attachment

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

A001

Technical Requirements Manual

Appendix I

(Amendment 48)

LaSalle Unit 1 Cycle 10A

Core Operating Limits Report

and

Reload Transient Analysis Results

Revision 0

Section 1

Core Operating Limits Report

for

LaSalle Unit 1 Cycle 10A

Issuance of Changes Summary

Affected Sections	Affected Pages	Summary of Changes	Revision	Date
All	All	Original Issue LaSalle Unit 1 Cycle 10A	0	5/2002

Technical Requirements Manual – Appendix I
L1C10A Core Operating Limits Report

Table of Contents

References

1. Exelon Generation Company, LLC Docket No. 50-373 LaSalle County Station, Unit 1, 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, October 3, 1988.

3. EMF-2690 Revision 0, "LaSalle Unit 1 Cycle 10 Reload Analysis," Framatome ANP, Inc., January 2002.

4. EMF-2563 (P) Revision 1, "Fuel Mechanical Design Report Exposure Extension for ATRIUM-9B Fuel Assemblies at Dresden, Quad Cities, and LaSalle Units," August 2001.

5. J11-03692-LHGR Revision 1, "ComEd GE9/GE10 LHGR Improvement Program," [NDIT NFM0000067 Sequence 00], February 2000.

6. Letter from A. Giancatarino to J. Nugent, "LaSalle Unit 1 and Unit 2 Rod Block Monitor COLR Setpoint Change," NFM:MW:01-0106, April 3, 2001.

7. Letter from D. Garber to R. Chin, "POWERPLEX-II CMSS Startup Testing", DEG:00:254, December 5, 2000.

8. Letter from D. Garber to R. Chin "POWERPLEX-II CMSS Startup Testing", DEG:00:256, December 6, 2000.

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

10. NEDC-31531 P and Supplement 1, "ARTS Improvement Program Analysis for LaSalle Units 1 and 2," December 1993 and June 1998, respectively.

11. EMF-2533 Revision 0, "LaSalle Unit 1 Cycle 10 Principal Transient Analysis Parameters," April 2001.

12. 24A5180AA Revision 0, "Lattice-Dependent MAPLHGR Report for LaSalle County Station Unit 1 Reload 7 Cycle 8," December 1995.

13. NFM Calculation No. BSA-L-99-07, "LaSalle GE9 MAPFACf Thermal Limit Multiplier for 105% Maximum Core Flow," October 1999.

14. GE-NE-187-13-0792 Revision 2, "Evaluation of a Postulated Slow Turbine Control Valve Closure Event For LaSalle County Station Units 1 and 2," NDIT NFM-98-00146 Sequence 00, July 1998.

15. Letter from R. Jacobs to R. Tsai, NFM:BSA:99-087, "Review of L1C9 Transient Analysis Results for Compliance with the Fuel Mechanical Limits for GE9 Fuel," September 21, 1999.

16. Letter from D. E. Garber to F. W. Trikur, "Transmittal of CBH effects on Fresh Fuel for LaSalle Unit 1 Cycle 10", DEG:02:012, January 11, 2002.

17. Letter from D. E. Garber to F. W. Trikur, "Licensing Letter Report for Impact of Revised Core Loading on LaSalle 1 Cycle 10 Licensing", DEG:02:094, May 23, 2002.

1. Average Planar Linear Heat Generation Rate (3.2.1)

1.1 Technical Specification Reference:

Section 3.2.1.

1.2 Description:

Tables 1-1 through 1-4 are used to determine the maximum average planar linear heat generation rate (MAPLHGR) limit for each fuel type. Limits given in Tables 1-1 through 1-4 are for Dual Reactor Recirculation Loop Operation.

For Single Reactor Recirculation Loop Operation (SLO), the MAPLHGR limits given in Tables 1-1 through 1-4 must be multiplied by a SLO MAPLHGR multiplier. The SLO MAPLHGR multiplier for ATRIUM-10 and ATRIUM-9B fuel is 0.90 (Reference 3 Page 7-1). The SLO MAPLHGR multipliers for GE9B fuel are shown in Table 1-5 ($MAPFAC_P$) and Table 1-6 ($MAPFAC_F$). The SLO MAPLHGR limit for the GE9B fuel is the product of the MAPLHGR limit from Table 1-3 or 1-4 and the minimum of either the SLO $MAPFAC_P$ or SLO $MAPFAC_F$ as found in Tables 1-5 and 1-6, respectively.

Table 1-1
Maximum Average Planar Linear Heat Generation Rate
(MAPLHGR) for ATRIUM-10 Fuel
A10-4039B-15GV75-100M
A10-4037B-16GV75-100M
(Bundle types 10, 11, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 41, 43, 45 and 49)
(Reference 3 Section 7.2.1)

Planar Average Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.0	12.5
15.0	12.5
55.0	9.1
64.0	7.6

Table 1-2
Maximum Average Planar Linear Heat Generation Rate
(MAPLHGR) for ATRIUM-9B Fuel
SPCA9-393B-16GZ-100M
SPCA9-396B-12GZB-100M
SPCA9-384B-11GZ-80M
SPCA9-396B-12GZC-100M
(Bundle types 6, 7, 8 and 9)
(Reference 3 Section 7.2.1)

Planar Average Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.0	13.5
20.0	13.5
64.3	9.07

Table 1-3
Maximum Average Planar Linear Heat Generation Rate
(MAPLHGR) for GE9B Fuel
GE9B-P8CWB342-10GZ-80M-150
(Bundle 3867, bundle type 5)
(References 5 and 12)

Planar Average Exposure (GWd/ST)	**Lattice Specific MAPLHGR limit (kW/ft)**					
0	12.66	12.04	12.25	11.72	12.09	12.66
0.200	12.59	12.08	12.28	11.77	12.12	12.59
1.000	12.40	12.16	12.35	11.87	12.22	12.40
2.000	12.34	12.28	12.45	12.00	12.37	12.34
3.000	12.34	12.42	12.55	12.13	12.53	12.34
4.000	12.37	12.57	12.65	12.27	12.70	12.37
5.000	12.40	12.73	12.76	12.41	12.88	12.40
6.000	12.43	12.89	12.87	12.56	13.07	12.43
7.000	12.46	13.06	12.98	12.72	13.27	12.46
8.000	12.48	13.24	13.10	12.88	13.47	12.48
9.000	12.50	13.42	13.21	13.05	13.65	12.50
10.000	12.51	13.61	13.31	13.21	13.76	12.51
12.500	12.35	13.79	13.35	13.31	13.82	12.35
15.000	11.98	13.50	13.06	13.05	13.51	11.98
20.000	11.20	12.79	12.47	12.45	12.79	11.20
25.000	10.42	11.95	11.67	11.63	11.95	10.42
27.2156	12.314	12.314	12.314	12.314	12.314	12.314
48.0808	10.800	10.800	10.800	10.800	10.800	10.800
58.9671	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	732	2087	2088	2089	2090	2091

Table 1-4
Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) for GE9B Fuel
GE9B-P8CWB343-12GZ-80M-150 (Bundle 3866, bundle type 4)

(References 5 and 12)

Planar Average Exposure (GWd/ST)	Lattice Specific MAPLHGR limit (kW/ft)				
0	12.66	11.69	11.37	10.92	12.66
0.200	12.59	11.71	11.43	10.99	12.59
1.000	12.40	11.78	11.55	11.13	12.40
2.000	12.34	11.95	11.72	11.33	12.34
3.000	12.34	12.16	11.91	11.54	12.34
4.000	12.37	12.40	12.11	11.76	12.37
5.000	12.40	12.67	12.32	12.00	12.40
6.000	12.43	12.90	12.53	12.24	12.43
7.000	12.46	13.05	12.76	12.49	12.46
8.000	12.48	13.21	12.98	12.75	12.48
9.000	12.50	13.37	13.13	13.01	12.50
10.000	12.51	13.54	13.30	13.22	12.51
12.500	12.35	13.75	13.60	13.57	12.35
15.000	11.98	13.48	13.23	13.21	11.98
20.000	11.20	12.71	12.40	12.37	11.20
25.000	10.42	11.92	11.60	11.57	10.42
27.2156	12.314	12.314	12.314	12.314	12.314
48.0808	10.800	10.800	10.800	10.800	10.800
58.9671	6.000	6.000	6.000	6.000	6.000
Lattice No.	732	2083	2084	2085	2086

Table 1-5
SLO MAPFAC$_P$ multiplier for GE9B Fuel

(References 5 and 10)

Core Thermal Power (% of rated)	MAPFAC$_P$ multiplier
0	0.4776
25	0.6082
100	1.0000

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power MAPFAC$_P$ multiplier should be applied.

Table 1-6
SLO $MAPFAC_F$ multiplier for GE9B Fuel
(References 5 and 13)

Core Flow (% of rated)	**$MAPFAC_F$ multiplier**
0	0.4672
25	0.6373
78.28	1.0000
105	1.0000

- Values are interpolated between relevant flow values.
- For core thermal monitoring at greater than 105% rated core flow, utilize $MAPFAC_F$ multiplier for 105% rated core flow.

2. Minimum Critical Power Ratio (3.2.2)

2.1 Technical Specification Reference:

Section 3.2.2.

2.2 Description:

MCPR limits from BOC to Coastdown are applicable up to a core average exposure of 31,495.1 MWd/MTU (which is the licensing basis exposure used by FANP). (Reference 3). Limits beyond the EOC exposure are not provided.

2.2.1 Manual Flow Control MCPR Limits

The Operating Limit MCPR (OLMCPR) is determined from either section 2.2.1.1 or 2.2.1.2, whichever is greater at any given power and flow condition.

2.2.1.1 Power-Dependent MCPR

The power-dependent MCPR value, $MCPR_P$, is determined from Tables 2-1 through 2-16, and is dependent on exposure (See Section 6, Note 4 for implementation details), fuel type and scram speed, in addition to power level. Tables 2-1, 2-2 and 2-5 through 2-14 are applicable to ATRIUM-10 fuel and Tables 2-3, 2-4, 2-15 and 2-16 are applicable to both ATRIUM-9B and GE9B fuel types.

2.2.1.2 Flow-Dependent MCPR

The flow dependent MCPR value, $MCPR_F$, is determined from Table 2-17 for all fuel types in Cycle 10A.

2.2.2 Automatic Flow Control MCPR Limits

Automatic Flow Control is not supported for L1C10A.

2.2.3 Nominal Scram Speeds

To utilize the MCPR limits for Nominal Scram Speeds (NSS), the core average scram speed insertion time must be equal to or less than the following values (Reference 11 Section 7.7).

Notch Position	Time (sec)
45	0.380
39	0.680
25	1.680
05	2.680

Table 2-1
$MCPR_P$

For BOC to First Cycle 10A Sequence Exchange - Applicable to all ATRIUM-10 Fuel

For First Cycle 10A Sequence Exchange to the Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - Applicable to all ATRIUM-10 Fuel Except Those Located in Cells 7B, 7C, 8A, 9B, 9C and 10B

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	2.07	1.52			1.43
EOOS Case 1	2.86	2.36	2.36	1.59			1.47
EOOS Case 2	2.86	2.36	2.36		1.81	1.74	1.54
EOOS Case 3	2.86	2.36	2.36	1.59			1.47
Single Loop Operation (SLO)	2.71	2.21	2.08	1.53			1.44
SLO with EOOS Case 1	2.87	2.37	2.37	1.60			1.48
SLO with EOOS Case 2	2.87	2.37	2.37		1.82	1.75	1.55
SLO with EOOS Case 3	2.87	2.37	2.37	1.60			1.48

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-2
$MCPR_P$

For BOC to First Cycle 10A Sequence Exchange - Applicable to all ATRIUM-10 Fuel

For First Cycle 10A Sequence Exchange to the Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - Applicable to all ATRIUM-10 Fuel Except Those Located in Cells 7B, 7C, 8A, 9B, 9C and 10B

Technical Specification Scram Speeds (TSSS)

(Reference 3 Table 5.2)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	2.15	1.55			1.46
EOOS Case 1	2.95	2.45	2.45	1.62			1.51
EOOS Case 2	2.95	2.45	2.45		1.82	1.74	1.59
EOOS Case 3	2.95	2.45	2.45	1.62			1.51
Single Loop Operation (SLO)	2.71	2.21	2.16	1.56			1.47
SLO with EOOS Case 1	2.96	2.46	2.46	1.63			1.52
SLO with EOOS Case 2	2.96	2.46	2.46		1.83	1.75	1.60
SLO with EOOS Case 3	2.96	2.46	2.46	1.63			1.52

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-3
$MCPR_P$

For BOC to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure -
For ATRIUM-9B and GE9B Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	1.95	1.50			1.42
EOOS Case 1	2.70	2.20	2.15	1.58			1.45
EOOS Case 2	2.70	2.20	2.15		1.86	1.67	1.52
EOOS Case 3	2.70	2.20	2.15	1.58			1.45
Single Loop Operation (SLO)	2.71	2.21	1.96	1.51			1.43
SLO with EOOS Case 1	2.71	2.21	2.16	1.59			1.46
SLO with EOOS Case 2	2.71	2.21	2.16		1.87	1.68	1.53
SLO with EOOS Case 3	2.71	2.21	2.16	1.59			1.46

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-4
$MCPR_P$

For BOC to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-9B and GE9B Fuel

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.2)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	1.96	1.54			1.44
EOOS Case 1	2.70	2.20	2.19	1.62			1.48
EOOS Case 2	2.70	2.20	2.19		1.86	1.73	1.59
EOOS Case 3	2.70	2.20	2.19	1.62			1.48
Single Loop Operation (SLO)	2.71	2.21	1.97	1.55			1.45
SLO with EOOS Case 1	2.71	2.21	2.20	1.63			1.49
SLO with EOOS Case 2	2.71	2.21	2.20		1.87	1.74	1.60
SLO with EOOS Case 3	2.71	2.21	2.20	1.63			1.49

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-5
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 9B Cells

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1 and Reference 16 Table 4.6)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.78	2.28	2.15	1.60	1.52	1.48	1.43
EOOS Case 1	2.94	2.44	2.44	1.67			1.55
EOOS Case 2	2.94	2.44	2.44		1.89	1.82	1.62
EOOS Case 3	2.94	2.44	2.44	1.67			1.55
Single Loop Operation (SLO)	2.79	2.29	2.16	1.61	1.53	1.49	1.44
SLO with EOOS Case 1	2.95	2.45	2.45	1.68			1.56
SLO with EOOS Case 2	2.95	2.45	2.45		1.90	1.83	1.63
SLO with EOOS Case 3	2.95	2.45	2.45	1.68			1.56

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.
- The 80% and 80(80.1)% values were determined from interpolation using the reference documents.

Table 2-6
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 9B Cells

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.2 and Reference 16 Table 4.6)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.78	2.28	2.23	1.63	1.55	1.51	1.46
EOOS Case 1	3.03	2.53	2.53	1.70			1.59
EOOS Case 2	3.03	2.53	2.53		1.90	1.82	1.67
EOOS Case 3	3.03	2.53	2.53	1.70			1.59
Single Loop Operation (SLO)	2.79	2.29	2.24	1.64	1.56	1.52	1.47
SLO with EOOS Case 1	3.04	2.54	2.54	1.71			1.60
SLO with EOOS Case 2	3.04	2.54	2.54		1.91	1.83	1.68
SLO with EOOS Case 3	3.04	2.54	2.54	1.71			1.60

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.
- The 80% and 80(80.1)% values were determined from interpolation using the reference documents.

Table 2-7
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 9C Cells

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1 and Reference 16 Table 4.6)

EOOS Combination	Core Thermal Power (% of rated)							
	0	25	25(25.1)	60	60(60.1)	80	80(80.1)	100
	$MCPR_P$							
Base Case Operation	2.74	2.24	2.11	1.56	1.52			1.43
EOOS Case 1	2.90	2.40	2.40	1.63				1.51
EOOS Case 2	2.90	2.40	2.40			1.85	1.78	1.58
EOOS Case 3	2.90	2.40	2.40	1.63				1.51
Single Loop Operation (SLO)	2.75	2.25	2.12	1.57	1.53			1.44
SLO with EOOS Case 1	2.91	2.41	2.41	1.64				1.52
SLO with EOOS Case 2	2.91	2.41	2.41			1.86	1.79	1.59
SLO with EOOS Case 3	2.91	2.41	2.41	1.64				1.52

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-8
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 9C Cells

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.2 and Reference 16 Table 4.6)

EOOS Combination	Core Thermal Power (% of rated)							
	0	25	25(25.1)	60	60(60.1)	80	80(80.1)	100
	$MCPR_P$							
Base Case Operation	2.74	2.24	2.19	1.59	1.55			1.46
EOOS Case 1	2.99	2.49	2.49	1.66				1.55
EOOS Case 2	2.99	2.49	2.49			1.86	1.78	1.63
EOOS Case 3	2.99	2.49	2.49	1.66				1.55
Single Loop Operation (SLO)	2.75	2.25	2.20	1.60	1.56			1.47
SLO with EOOS Case 1	3.00	2.50	2.50	1.67				1.56
SLO with EOOS Case 2	3.00	2.50	2.50			1.87	1.79	1.64
SLO with EOOS Case 3	3.00	2.50	2.50	1.67				1.56

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-9
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure – For ATRIUM-10 Fuel Located in 7B and 8A Cells

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1 and Reference 16 Table 4.7)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.72	2.22	2.09	1.54			1.45
EOOS Case 1	2.88	2.38	2.38	1.61			1.49
EOOS Case 2	2.88	2.38	2.38		1.83	1.76	1.56
EOOS Case 3	2.88	2.38	2.38	1.61			1.49
Single Loop Operation (SLO)	2.73	2.23	2.10	1.55			1.46
SLO with EOOS Case 1	2.89	2.39	2.39	1.62			1.50
SLO with EOOS Case 2	2.89	2.39	2.39		1.84	1.77	1.57
SLO with EOOS Case 3	2.89	2.39	2.39	1.62			1.50

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-10
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 7B and 8A Cells

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.2 and Reference 16 Table 4.7)

EOOS Combination	**Core Thermal Power (% of rated)**						
	0	**25**	**25(25.1)**	**60**	**80**	**80(80.1)**	**100**
	$MCPR_P$						
Base Case Operation	2.72	2.22	2.17	1.57			1.48
EOOS Case 1	2.97	2.47	2.47	1.64			1.53
EOOS Case 2	2.97	2.47	2.47		1.84	1.76	1.61
EOOS Case 3	2.97	2.47	2.47	1.64			1.53
Single Loop Operation (SLO)	2.73	2.23	2.18	1.58			1.49
SLO with EOOS Case 1	2.98	2.48	2.48	1.65			1.54
SLO with EOOS Case 2	2.98	2.48	2.48		1.85	1.77	1.62
SLO with EOOS Case 3	2.98	2.48	2.48	1.65			1.54

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-11
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 7C and 10B Cells

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1 and Reference 16 Table 4.7)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.73	2.23	2.10	1.55			1.46
EOOS Case 1	2.89	2.39	2.39	1.62			1.50
EOOS Case 2	2.89	2.39	2.39		1.84	1.77	1.57
EOOS Case 3	2.89	2.39	2.39	1.62			1.50
Single Loop Operation (SLO)	2.74	2.24	2.11	1.56			1.47
SLO with EOOS Case 1	2.90	2.40	2.40	1.63			1.51
SLO with EOOS Case 2	2.90	2.40	2.40		1.85	1.78	1.58
SLO with EOOS Case 3	2.90	2.40	2.40	1.63			1.51

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-12
$MCPR_P$

For First Cycle 10A Sequence Exchange to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel Located in 7C and 10B Cells

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.2 and Reference 16 Table 4.7)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.73	2.23	2.18	1.58			1.49
EOOS Case 1	2.98	2.48	2.48	1.65			1.54
EOOS Case 2	2.98	2.48	2.48		1.85	1.77	1.62
EOOS Case 3	2.98	2.48	2.48	1.65			1.54
Single Loop Operation (SLO)	2.74	2.24	2.19	1.59			1.50
SLO with EOOS Case 1	2.99	2.49	2.49	1.66			1.55
SLO with EOOS Case 2	2.99	2.49	2.49		1.86	1.78	1.63
SLO with EOOS Case 3	2.99	2.49	2.49	1.66			1.55

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-13
$MCPR_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) - For ATRIUM-10 Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.3)

EOOS Combination	**Core Thermal Power (% of rated)**						
	0	**25**	**25(25.1)**	**60**	**80**	**80(80.1)**	**100**
	$MCPR_P$						
Base Case Operation	2.70	2.20	2.07	1.52			1.47
EOOS Case 1	2.86	2.36	2.36	1.59			1.47
EOOS Case 2	2.86	2.36	2.36		1.81	1.74	1.59
EOOS Case 3	2.86	2.36	2.36	1.59			1.47
Single Loop Operation (SLO)	2.71	2.21	2.08	1.53			1.48
SLO with EOOS Case 1	2.87	2.37	2.37	1.60			1.48
SLO with EOOS Case 2	2.87	2.37	2.37		1.82	1.75	1.60
SLO with EOOS Case 3	2.87	2.37	2.37	1.60			1.48

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-14
$MCPR_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) - For ATRIUM-10 Fuel

Technical Specification Scram Speeds (TSSS)

(Reference 3 Table 5.4)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	2.15	1.55			1.50
EOOS Case 1	2.95	2.45	2.45	1.62			1.51
EOOS Case 2	2.95	2.45	2.45		1.82	1.74	1.64
EOOS Case 3	2.95	2.45	2.45	1.62			1.51
Single Loop Operation (SLO)	2.71	2.21	2.16	1.56			1.51
SLO with EOOS Case 1	2.96	2.46	2.46	1.63			1.52
SLO with EOOS Case 2	2.96	2.46	2.46		1.83	1.75	1.65
SLO with EOOS Case 3	2.96	2.46	2.46	1.63			1.52

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-15
$MCPR_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) - For ATRIUM-9B and GE9B Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.3)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	1.95	1.50			1.43
EOOS Case 1	2.70	2.20	2.15	1.58			1.45
EOOS Case 2	2.70	2.20	2.15		1.86	1.67	1.58
EOOS Case 3	2.70	2.20	2.15	1.58			1.45
Single Loop Operation (SLO)	2.71	2.21	1.96	1.51			1.44
SLO with EOOS Case 1	2.71	2.21	2.16	1.59			1.46
SLO with EOOS Case 2	2.71	2.21	2.16		1.87	1.68	1.59
SLO with EOOS Case 3	2.71	2.21	2.16	1.59			1.46

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $MCPR_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-16
$MCPR_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) - For ATRIUM-9B and GE9B Fuel

Technical Specification Scram Speeds (TSSS)

(Reference 3 Table 5.4)

EOOS Combination	Core Thermal Power (% of rated)						
	0	25	25(25.1)	60	80	80(80.1)	100
	$MCPR_P$						
Base Case Operation	2.70	2.20	1.96	1.54			1.44
EOOS Case 1	2.70	2.20	2.19	1.62			1.48
EOOS Case 2	2.70	2.20	2.19		1.86	1.73	1.65
EOOS Case 3	2.70	2.20	2.19	1.62			1.48
Single Loop Operation (SLO)	2.71	2.21	1.97	1.55			1.45
SLO with EOOS Case 1	2.71	2.21	2.20	1.63			1.49
SLO with EOOS Case 2	2.71	2.21	2.20		1.87	1.74	1.66
SLO with EOOS Case 3	2.71	2.21	2.20	1.63			1.49

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $LHGRFAC_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 2-17
$MCPR_F$ limits for ATRIUM-10, ATRIUM-9B, and GE9B Fuel
(Reference 3 Figure 5.1)

Flow (% of rated)	$MCPR_F$
0	1.63
30	1.63
100	1.19
105	1.11

- Values are interpolated between relevant flow values.
- Values presented in Table 2-17 are applicable to all Operating Domains and EOOS conditions in Section 6.
- For thermal limit monitoring at greater than 105% rated core flow, utilize the $MCPR_F$ limit for 105% rated core flow.

3. Linear Heat Generation Rate (3.2.3)

3.1 Technical Specification Reference:

Section 3.2.3.

3.2 Description:

The LHGR Limit is the product of the LHGR Limit from Tables 3-1, 3-2, 3-3, 3-4 or 3-5 and the minimum of either the power dependent LHGR Factor, $LHGRFAC_P$, or the flow dependent LHGR Factor, $LHGRFAC_F$. The applicable power dependent LHGR Factor ($LHGRFAC_P$) is determined from Table 3-6, 3-7, 3-8 or 3-9 for ATRIUM-10 fuel, Table 3-10, 3-11, 3-12 or 3-13 for ATRIUM-9B fuel or Table 3-14 or 3-15 for GE9B fuel. The applicable flow dependent LHGR Factor ($LHGRFAC_F$) is determined from Table 3-16 for ATRIUM-10 and ATRIUM-9B fuels or Table 3-17 for GE9B fuel.

Table 3-1
Steady-State LHGR Limits for all ATRIUM-10 Fuel
Except those Located in Cell Locations 8A and 10A
A10-4039B-15GV75-100M
A10-4037B-16GV75-100M
(Bundle types 10, 11, 20, 21, 22, 24, 26, 27, 28, 29, 31, 32, 41, 45 and 49)
(Reference 3 Section 7.2.3)

Average Planar Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.0	13.4
15.0	13.4
55.0	9.1
64.0	7.3

Table 3-2
Steady-State LHGR Limits for ATRIUM-10 Fuel
Located in Cell Locations 8A and 10A
A10-4039B-15GV75-100M
A10-4037B-16GV75-100M
(Bundle types 23, 30 and 43)
(Reference 3 Section 7.2.3 and Reference 16 Table 4.4)

Average Planar Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.0	13.3
15.0	13.3
55.0	9.0
64.0	7.2

Table 3-3
Steady-State LHGR Limits for ATRIUM-9B Fuel
SPCA9-393B-16GZ-100M
SPCA9-396B-12GZB-100M
SPCA9-384B-11GZ-80M
SPCA9-396B-12GZC-100M
(Bundle types 6, 7, 8 and 9)
(Reference 3 Section 7.2.3)

Average Planar Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.0	14.4
15.0	14.4
64.3	7.9

Table 3-4
LHGR Limits for GE9B Fuel
GE9B-P8CWB343-12GZ-80M-150
(Bundle 3866, bundle type 4)
(Reference 5 Page 47)

Average Planar 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

Table 3-5
LHGR Limits for GE9B Fuel
GE9B-P8CWB342-10GZ-80M-150
(Bundle 3867, bundle type 5)
(Reference 5 Page 47)

Average Planar 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

Table 3-6
$LHGRFAC_P$

For BOC to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1)

EOOS Combination	**Core Thermal Power (% of rated)**				
	0	**25**	**60**	**80**	**100**
	$LHGRFAC_P$ multiplier				
Base Case Operation	0.75	0.75	1.00		1.00
EOOS Case 1	0.66	0.66	0.94	0.94	0.95
EOOS Case 2	0.65	0.65		0.88	0.89
EOOS Case 3	0.66	0.66	0.77	0.77	0.83
Single Loop Operation (SLO)	0.75	0.75	1.00		1.00
SLO with EOOS Case 1	0.66	0.66	0.94	0.94	0.95
SLO with EOOS Case 2	0.65	0.65		0.88	0.89
SLO with EOOS Case 3	0.66	0.66	0.77	0.77	0.83

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $LHGRFAC_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-7
LHGRFAC$_P$

For BOC to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-10 Fuel

Technical Specification Scram Speeds (TSSS)

(Reference 3 Table 5.2)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	40	60	80	100
	LHGRFAC$_P$ multiplier					
Base Case Operation	0.74	0.74		1.00		1.00
EOOS Case 1	0.64	0.64		0.94	0.94	0.95
EOOS Case 2	0.64	0.64			0.87	0.87
EOOS Case 3	0.64	0.64	0.77	0.77	0.77	0.83
Single Loop Operation (SLO)	0.74	0.74		1.00		1.00
SLO with EOOS Case 1	0.64	0.64		0.94	0.94	0.95
SLO with EOOS Case 2	0.64	0.64			0.87	0.87
SLO with EOOS Case 3	0.64	0.64	0.77	0.77	0.77	0.83

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-8
$LHGRFAC_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) - For ATRIUM-10 Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.3)

EOOS Combination	**Core Thermal Power (% of rated)**				
	0	**25**	**60**	**80**	**100**
	$LHGRFAC_P$ multiplier				
Base Case Operation	0.75	0.75	1.00		1.00
EOOS Case 1	0.66	0.66	0.94	0.94	0.95
EOOS Case 2	0.65	0.65		0.84	0.84
EOOS Case 3	0.65	0.65	0.77	0.77	0.83
Single Loop Operation (SLO)	0.75	0.75	1.00		1.00
SLO with EOOS Case 1	0.66	0.66	0.94	0.94	0.95
SLO with EOOS Case 2	0.65	0.65		0.84	0.84
SLO with EOOS Case 3	0.65	0.65	0.77	0.77	0.83

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $LHGRFAC_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-9
LHGRFAC$_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) -
For ATRIUM-10 Fuel

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.4)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	40	60	80	100
	LHGRFAC$_P$ multiplier					
Base Case Operation	0.74	0.74		1.00		1.00
EOOS Case 1	0.64	0.64		0.94	0.94	0.95
EOOS Case 2	0.64	0.64			0.82	0.82
EOOS Case 3	0.64	0.64	0.77	0.77	0.77	0.83
Single Loop Operation (SLO)	0.74	0.74		1.00		1.00
SLO with EOOS Case 1	0.64	0.64		0.94	0.94	0.95
SLO with EOOS Case 2	0.64	0.64			0.82	0.82
SLO with EOOS Case 3	0.64	0.64	0.77	0.77	0.77	0.83

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-10
LHGRFAC$_P$

For BOC to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure -
For ATRIUM-9B Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.1)

EOOS Combination	Core Thermal Power (% of rated)				
	0	25	60	80	100
	LHGRFAC$_P$ multiplier				
Base Case Operation	0.77	0.77	1.00		1.00
EOOS Case 1	0.69	0.69	0.90	0.90	0.90
EOOS Case 2	0.67	0.67		0.79	0.79
EOOS Case 3	0.69	0.69	0.77	0.77	0.80
Single Loop Operation (SLO)	0.77	0.77	1.00		1.00
SLO with EOOS Case 1	0.69	0.69	0.90	0.90	0.90
SLO with EOOS Case 2	0.67	0.67		0.79	0.79
SLO with EOOS Case 3	0.69	0.69	0.77	0.77	0.80

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-11
LHGRFAC$_P$

For BOC to Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure - For ATRIUM-9B Fuel

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.2)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	40	60	80	100
	LHGRFAC$_P$ multiplier					
Base Case Operation	0.76	0.76		1.00		1.00
EOOS Case 1	0.69	0.69		0.89	0.91	0.92
EOOS Case 2	0.67	0.67			0.76	0.76
EOOS Case 3	0.69	0.69	0.77	0.77	0.77	0.80
Single Loop Operation (SLO)	0.76	0.76		1.00		1.00
SLO with EOOS Case 1	0.69	0.69		0.89	0.91	0.92
SLO with EOOS Case 2	0.67	0.67			0.76	0.76
SLO with EOOS Case 3	0.69	0.69	0.77	0.77	0.77	0.80

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-12
$LHGRFAC_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) -
For ATRIUM-9B Fuel

Nominal Scram Speeds (NSS)
(Reference 3 Table 5.3)

EOOS Combination	Core Thermal Power (% of rated)				
	0	25	60	80	100
	$LHGRFAC_P$ multiplier				
Base Case Operation	0.76	0.76	1.00		1.00
EOOS Case 1	0.69	0.69	0.90	0.90	0.90
EOOS Case 2	0.67	0.67		0.79	0.79
EOOS Case 3	0.69	0.69	0.77	0.77	0.80
Single Loop Operation (SLO)	0.76	0.76	1.00		1.00
SLO with EOOS Case 1	0.69	0.69	0.90	0.90	0.90
SLO with EOOS Case 2	0.67	0.67		0.79	0.79
SLO with EOOS Case 3	0.69	0.69	0.77	0.77	0.80

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power $LHGRFAC_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6.

Table 3-13
LHGRFAC$_P$

For Final Sequence Exchange at 12,000 MWd/MT Cycle Exposure to Coastdown (EOC) -
For ATRIUM-9B Fuel

Technical Specification Scram Speeds (TSSS)
(Reference 3 Table 5.4)

EOOS Combination	Core Thermal Power (% of rated)					
	0	25	40	60	80	100
	LHGRFAC$_P$ multiplier					
Base Case Operation	0.76	0.76		1.00		1.00
EOOS Case 1	0.69	0.69		0.89	0.91	0.92
EOOS Case 2	0.67	0.67			0.76	0.76
EOOS Case 3	0.69	0.69	0.77	0.77	0.77	0.80
Single Loop Operation (SLO)	0.76	0.76		1.00		1.00
SLO with EOOS Case 1	0.69	0.69		0.89	0.91	0.92
SLO with EOOS Case 2	0.67	0.67			0.76	0.76
SLO with EOOS Case 3	0.69	0.69	0.77	0.77	0.77	0.80

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 6

Table 3-14
LHGRFAC$_P$ multipliers for GE9B Fuel except TCV Slow Closure
(References 3, 5, 10 and 15)

Core Thermal Power (% of rated)	LHGRFAC$_P$ Multiplier
0	0.4776
25	0.6082
100	1.0000

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Table 3-14 is only applicable for EOOS Case 2.

Table 3-15
LHGRFAC$_P$ multipliers for GE9B Fuel for TCV Slow Closure
(References 3, 5, 14 and 15)

Core Thermal Power (% of rated)	LHGRFAC$_P$ Multiplier
0	0.2000
25	0.4000
100	1.0000

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.

Table 3-16
$LHGRFAC_F$ multipliers for ATRIUM-10 and ATRIUM-9B Fuel
(Reference 3 Figure 5.2)

Core Flow (% of rated)	$LHGRFAC_F$ Multiplier
0	0.72
30	0.72
68	1.00
105	1.00

- Values are interpolated between relevant flow values.
- For thermal limit monitoring above 105% rated core flow, utilize the 105% rated core flow $LHGRFAC_F$ multiplier.
- Values presented in Table 3-16 are applicable to all Operating Domains and EOOS conditions in Section 6.

Table 3-17
$LHGRFAC_F$ multipliers for GE9B Fuel
(References 3, 5, 13 and 15)

Core Flow (% of rated)	$LHGRFAC_F$ Multiplier
0	0.4672
25	0.6373
78.28	1.0000
105	1.0000

- Values are interpolated between relevant flow values.
- For thermal limit monitoring above 105% rated core flow, utilize the 105% rated core flow $LHGRFAC_F$ multiplier.
- Values presented in Table 3-17 are applicable to all Operating Domains and EOOS conditions in Section 6.

4. Control Rod Withdrawal Block Instrumentation (3.3.2.1)

4.1 Technical Specification Reference:

Table 3.3.2.1-1

4.2 Description:

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below (Reference 6):

ROD BLOCK MONITOR UPSCALE TRIP FUNCTION	ALLOWABLE VALUE
Two Recirculation Loop Operation	$0.66\ W_d + 54\%$
Single Recirculation Loop Operation	$0.66\ W_d + 48.7\%$

The setpoint may be lower/higher and will still comply with the Rod Withdrawal Error (RWE) Analysis because RWE is analyzed unblocked. The allowable value is clamped, with a maximum value not to exceed the allowable value for a recirculation loop flow (W_d) of 100%.

W_d – percent of recirculation loop flow required to produce a rated core flow of 108.5 Mlb/hr.

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

5.1 Technical Specification Reference:

Technical Specification 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.

5.2 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.

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 7, 8 and 9) 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.

5.3 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 the simulation and adjustment process could introduce uncertainty, a maximum of 18 channels may be simulated to ensure that the uncertainties assumed in the substitution process methodology remain valid.

6. 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:

	----------OPERATING REGION---------				
Equipment Out of Service Options[1,4]	**ELLLA**	**MELLLA**	**ICF[7]**	**Coastdown[3]**	**POWERPLEX Thermal Limit Set Number[4]**
Base Case Operation – NSS	Yes	Yes	Yes	No	1, 17, 33
EOOS Case 1 – NSS FHOOS[5] or TBVOOS[2]	Yes Except FHOOS[8]	Yes Except FHOOS[8]	Yes	No	2, 18, 34
EOOS Case 2 – NSS Any combination of TCV slow closure, no RPT or FHOOS[5]	Yes Except FHOOS[8]	Yes Except FHOOS[8]	Yes	No	3, 19, 35
EOOS Case 3 – NSS TBVOOS with 1 TCV stuck closed	Yes	Yes	Yes	No	4, 20, 36
Single Loop Operation (SLO) – NSS	Yes	No[6]	N/A	No	5, 21, 37
SLO with EOOS Case 1 – NSS FHOOS[5] or TBVOOS[2]	Yes Except FHOOS[8]	No[6]	N/A	No	6, 22, 38
SLO with EOOS Case 2 – NSS Any combination of TCV slow closure, no RPT or FHOOS[5]	Yes Except FHOOS[8]	No[6]	N/A	No	7, 23, 39
SLO with EOOS Case 3 – NSS TBVOOS with 1 TCV stuck closed	Yes	No[6]	N/A	No	8, 24, 40
Base Case Operation – TSSS	Yes	Yes	Yes	No	9, 25, 41
EOOS Case 1 – TSSS FHOOS[5] or TBVOOS[2]	Yes Except FHOOS[8]	Yes Except FHOOS[8]	Yes	No	10, 26, 42
EOOS Case 2 – TSSS Any combination of TCV slow closure, no RPT or FHOOS[5]	Yes Except FHOOS[8]	Yes Except FHOOS[8]	Yes	No	11, 27, 43
EOOS Case 3 - TSSS TBVOOS with 1 TCV stuck closed	Yes	Yes	Yes	No	12, 28, 44
Single Loop Operation (SLO) – TSSS	Yes	No[6]	N/A	No	13, 29, 45
SLO with EOOS Case 1 – TSSS FHOOS[5] or TBVOOS[2]	Yes Except FHOOS[8]	No[6]	N/A	No	14, 30, 46
SLO with EOOS Case 2 – TSSS Any combination of TCV slow closure, no RPT or FHOOS[5]	Yes Except FHOOS[8]	No[6]	N/A	No	15, 31, 47
SLO with EOOS Case 3 – TSSS TBVOOS with 1 TCV stuck closed	Yes	No[6]	N/A	No	16, 32, 48

[1] Each OOS Option may be combined with 1 SRVOOS, 1 TCV stuck closed (except TBVOOS conditions), a 20°F reduction in feedwater temperature (without feedwater heaters considered OOS), up to 2 TIP OOS (or the equivalent number of TIP channels, 42% of the total number of channels with 100% available at startup), and up to 50% of the LPRMs OOS with an LPRM calibration frequency of

1250 Effective Full Power Hours (EFPH) (1000 EFPH +25%) (Reference 3 Tables 1.1 and 5.1 through 5.4).

[2] All EOOS options support 1 TCV stuck closed except EOOS Case 1 TBVOOS. If TBVOOS is being utilized while 1 TCV is stuck closed, utilize EOOS Case 3 with the applicable scram speed (Reference 3 Tables 1.1 and 5.1 through 5.4).

[3] Coastdown limits are not provided. Coastdown limits will not be required based on current burnup projections. Feedwater heaters OOS (FHOOS) may be intentionally entered to maintain core thermal power provided the end of cycle exposure corresponding to a core average exposure of 31,495.1 MWd/MTU is not exceeded.

[4] Three sets of thermal limits are provided. The first set of thermal limits, from 1 through 16, are provided for use from the beginning of cycle until the first Cycle 10A sequence exchange (from A2 to A1) at approximately 3000 MWd/MTU. The second set of thermal limits, from 17 through 32, are provided for use from the first Cycle 10A sequence exchange (from A2 to A1) at approximately 3000 MWd/MTU until approximately 12,000 MWd/MTU defined as where the final Cycle 10A sequence exchange (from A1 to A2) takes place. The final sequence exchange may not take place any later than 12,200 MWd/MTU. The third set of thermal limits, from 33 through 48, are applicable from approximately 12,000 MWd/MTU defined as where the final Cycle 10A sequence exchange (from A1 to A2) takes place to the end of cycle. The licensing basis end of cycle burnup corresponds to a core exposure of 31,495.1 MWd/MTU. Note that the nominal exposures at the beginning and end of the penalty period may be adjusted by ±200 MWd/MTU without affecting the magnitude of the penalties reported (Reference 16). The thermal limit sets are to be changed when the sequence exchange is performed and not at the specific cycle exposures.

[5] Feedwater heaters OOS (FHOOS) supports a reduction of up to 100°F in feedwater temperature. FHOOS may be an intentionally entered mode of operation or an actual OOS condition. Feedwater heaters OOS (FHOOS) may be intentionally entered to maintain core thermal power provided the end of cycle exposure corresponding to a core average exposure of 31,495.1 MWd/MTU is not exceeded.

[6] The SLO boundary was not moved up with the incorporation of MELLLA. The power-flow boundary for SLO at power uprated conditions remains the ELLLA boundary for pre-uprate conditions.

[7] ICF is analyzed up to 105% rated core flow.

[8] If operating with FHOOS (alone or in combination with other EOOS), operation in the ELLLA or MELLLA region is supported by current transient analyses, but is administratively limited to less than 100% flow control line due to stability concerns.

7. Methodology (5.6.5)

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. XN-NF-81-58 (P)(A), Revision 2 and Supplements 1 and 2, "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," March 1984.
2. Letter from Ashok C. Thadini (NRC) to R.A. Copeland (SPC), "Acceptance for Referencing of ULTRAFLOW™ Spacer on 9x9-IX/X BWR Fuel Design," July 28, 1993.
3. ANF-524 (P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," November 1990.
4. XN-NF-80-19 (P)(A) Volume 1 Supplement 3, Supplement 3 Appendix F, and Supplement 4, "Advanced Nuclear Fuels Methodology for Boiling Water Reactors: Benchmark Results for CASMO-3G/MICROBURN-B Calculation Methodology," November 1990.
5. XN-NF-85-67 (P)(A) Revision 1, "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," September 1986.
6. ANF-913 (P)(A) Volume 1 Revision 1, and Volume 1 Supplements 2, 3, 4, "COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses," August 1990.
7. XN-NF-84-105 (P)(A), Volume 1 and Volume 1 Supplements 1 and 2; Volume 1 Supplement 4, "XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis," February 1987 and June 1988, respectively.
8. ANF-89-014 (P)(A) Revision 1 and Supplements 1 & 2, "Generic Mechanical Design for Advanced Nuclear Fuels Corporation 9X9 – IX and 9x9 – 9X BWR Reload Fuel," October 1991.
9. EMF-2209 (P)(A), Revision 1, "SPCB Critical Power Correlation," July 2000.
10. ANF-89-98 (P)(A), Revision 1 and Revision 1 Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," May 1995.
11. ANF-91-048 (P)(A), "Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR ECCS Evaluation Model," January 1993.
12. Commonwealth Edison Company Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods," Revision 0 and Supplements on Neutronics Licensing Analysis (Supplement 1) and La Salle County Unit 2 benchmarking (Supplement 2), December 1991, March 1992, and May 1992, respectively.
13. EMF-85-74 (P)(A) Revision 0 and Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," February 1998.
14. NEDE-24011-P-A-14, "General Electric Standard Application for Reactor Fuel (GESTAR)," June 2000.
15. EMF-CC-074 (P) Volume 4 Revision 0, "BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2, August 2000.
16. ANF-1125 (P)(A) and ANF-1125(P)(A) Supplements 1 and 2, "ANFB Critical Power Correlation," Advanced Nuclear Fuels Corporation, April 1990.

17. ANF-1125 (P)(A) Supplement 1 Appendix E, "ANFB Critical Power Correlation Determination of ATRIUM™-9B Additive Constant Uncertainties," September 1998.

18. EMF-1125 (P)(A) Supplement 1 Appendix C, "ANFB Critical Power Correlation Application for Co-Resident Fuel," August 1997.

19. Commonwealth Edison Topical Report NFSR-0085 Revision 0, "Benchmark of BWR Nuclear Design Methods," November 1990.

20. Commonwealth Edison Topical Report NFSR-0085 Supplement 1 Revision 0, "Benchmark of BWR Nuclear Design Methods – Quad Cities Gamma Scan Comparisons," April 1991.

21. Commonwealth Edison Topical Report NFSR-0085 Supplement 2 Revision 0, "Benchmark of BWR Nuclear Design Methods – Neutronic Licensing Analyses," April 1991.

22. ANF-CC-33(P)(A) Supplement 1 Revision 1 and Supplement 2, "HUXY: A Generalized Multirod Heatup Code with 10CFR50, Appendix K Heatup Option," August 1986 and January 1991, respectively.

23. XN-NF-80-19 (P)(A) Volume 4 Revision 1, "Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads," June 1986.

24. XN-NF-80-19 (P)(A) Volume 3 Revision 2, "Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description," January 1987.

25. ANF-91-048 (P)(A) Supplement 1 and Supplement 2, "BWR Jet Pump Model Revision for RELAX," October 1997.

26. XN-NF-80-19 (P)(A) Volumes 2, 2A, 2B, and 2C, "Exxon Nuclear Methodology for Boiling Water Reactors: EXEM BWR ECCS Evaluation Model," September 1982.

27. XN-NF-80-19 (P)(A) Volume 1 and Supplements 1 and 2, "Exxon Nuclear Methodology for Boiling Water Reactors – Neutronic Methods for Design and Analysis," March 1983.

Section 2

LaSalle Unit 1 Cycle 10A

Reload Transient Analysis Results

Technical Requirements Manual – Appendix I
L1C10A Reload Transient Analysis Results

Table of Contents

Attachment 1

LaSalle Unit 1 Cycle 10A

Supplemental Licensing Report Information

NUCLEAR FUEL MANAGEMENT
TRANSMITTAL OF DESIGN INFORMATION

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) ________	NFM ID# NFM0200004 Sequence 0 Page 1 of 7

Station: LaSalle Unit: 1 Cycle: 10 Generic: X

To: Kirk W. Peterman (LaSalle)

Subject:

LaSalle Unit 1 Cycle 10 Supplemental Licensing Report Information

Frank W. Trikur [signature] 1-9-02
Preparer Preparer's Signature Date

Jill T Fisher Jill T Fisher 1/9/2002
Bryan K. Currie Bryan Currie 1/9/02

Anthony D. Giancatarino [signature] 1-9-02
NFM Department Head Approver's Signature Date

Status of Information:

☒ Verified
☐ Unverified
☐ Engineering Judgement

Action Tracking #. for Method and Schedule of Verification for Unverified DESIGN INFORMATION : ____________

Description of Information: The information included in this transmittal are LaSalle Cold Shutdown Margin information, fuel type exposure limits, and the applicable L1C10 GE-9 thermal limits (LHGR, $LHGRFAC_f$, $LHGRFAC_p$, $MAPFAC_f$, and $MAPFAC_p$).

Purpose of Information: Provide documentation of reload limits (e.g. SDM, thermal limits, fuel exposure) for the L1C10 reload design.

Sources of Information:
Reference 1. EMF-2563(P), Rev. 1, Fuel Mechanical Design Report Exposure Extension for ATRIUM-9B Fuel Assemblies at Dresden, Quad Cities, and LaSalle Units.
Reference 2. EMF-2589(P), Rev. 0, Mechanical and Thermal Hydraulic Design Report for LaSalle Units 1 & 2, ATRIUM-10 Fuel Assemblies.
Reference 3. "ComEd GE9/GE10 LHGR Improvement Program", J11-03692-LHGR, Rev. 1, February 2000.
Reference 4. "ARTS Improvement Program Analysis for LaSalle County Stations Unit 1 and 2", NEDC-31531P, December 1993 and Supplement 1, June 1998.
Reference 5. "Project Task Report, LaSalle County Station, Power Uprate Evaluation, Task 407: ECCS Performance" GE-NE-A1300384-39-01, Rev. ~~0~~ 1, September 1999 JTF 1/9/2002
Reference 6. "Evaluation of a Postulated Slow Turbine Control Valve Closure Event for LaSalle County Nuclear Station, Units 1 and 2, GE-NE-187-13-0792, Revision 2, July 1998.
Reference 7. NFM Calculation No. BSA-L-99-07, "MAPFACf Thermal Limit Multiplier for 105% Maximum Core Flow"
Reference 8. "Fuel Design Report for LaSalle Unit 2 Cycle 9 ATRIUM-9B Fuel Assemblies", EMF-2404(P), Revision 1, September 2000.

Supplemental Hardcopy Distribution: LaSalle Central File, Cantera Records Management
Supplemental Electronic Distribution: Norha Z. Plumey, Jeff K. Nugent

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 9 exposure of 19100 MWd/MTU.

BOC Cold K-Effective, Strongest Rod Out	0.99325
BOC Shutdown Margin, % ΔK	1.17
Minimum Shutdown Margin, % ΔK	1.17
Cycle Exposure(s) of Minimum Shutdown Margin, MWD/MT	0.0
Reactivity Defect (R-value) Total, % ΔK	0.0

1.7.02
MYH, 1-9-02

Maximum Exposure Limit Compliance

Note that the projected exposures listed below are based on the nominal Cycle 9 (Cycle N-1) exposure, 19600 MWD/MT, and the licensing basis Cycle 10 (Cycle N) cycle exposure of 18600 MWD/MT. The exposure limits are identified in References 1, 2 and 8.

Exposure Criteria	GE9B Projected Exposure (GWD/MT)	GE9B Exposure Limit (GWD/MT)	ATRIUM-9B (100-mil) Projected Exposure (GWD/MT)	ATRIUM-9B (100-mil) Exposure Limit (GWD/MT)	ATRIUM-9B (80-mil) Projected Exposure (GWD/MT)	ATRIUM-9B (80-mil) Exposure Limit (GWD/MT)	ATRIUM-10 Projected Exposure (GWD/MT)	ATRIUM-10 Exposure Limit (GWD/MT)
Peak Fuel Assembly	N/A	N/A	45.8	50.5	43.7	48.0	23.2	54.0
Peak Fuel Batch	38.1	42.0	N/A	N/A	N/A	N/A	N/A	N/A
Peak Fuel Rod	N/A	N/A	49.5	57.9	47.3	55.0	26.4	58.7
Peak Fuel Pellet	57.2	65.0	63.1	69.4	60.5	66.0	34.8	70.4

1.9.02

1-9-02

GE9B Thermal Limits

The following tables contain the GE9B thermal limits (LHGR, $LHGRFAC_f$, $LHGRFAC_p$, $MAPFAC_f$, and $MAPFAC_p$). These limits were reviewed and approved previously for use in LaSalle Unit 1 Cycle 9 and previously presented in the Cycle 9 COLR. The GE9 fuel that currently resides in the LaSalle Unit 1 Cycle 10 core are located on the core periphery and in non-limiting locations. It was evaluated that the previous GE9 Cycle 9 thermal limits are therefore applicable to the GE9 fuel used in Cycle 10.

LHGR Limit

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 Tables 3 and 4 and Figure 1. The following LHGR limits apply for the entire cycle exposure range: (References 3, 4, and 5)

Table 1. GE9B-P8CWB343-12GZ-80M-150 (bundle 3866 in Reference 3)

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

Table 2. GE9B-P8CWB342-10GZ-80M-150 (bundle 3867 in Reference 3)

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

* For thermal limit monitoring cases at greater than 100% power, the 100% power $LHGRFAC_p$ limits should be applied

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$LHGRFAC_p$

Table 3. Power Dependent LHGR Multipliers for GE Fuel (formerly $MAPFAC_p$) (References 3 and 4)

Power	($LHGRFAC_p$) Value
25>P	No Thermal Limit Monitoring Required; If official monitoring is desired, the equations for ≥25% Power may be extrapolated for 25>P, provided the official monitoring is only performed with the TCV/TSV closure scrams and RPT enabled.
25≤P≤100	$LHGRFAC_p$ = 1.0+0.005224(P-100)
100<P	$LHGRFAC_p$ = 1.0

P = % Rated Thermal Power

Table 4. Power Dependent LHGR Multipliers for GE Fuel (TCV(s) Slow Closure) (Formerly $MAPFAC_p$) (References 3 and 6)

Power	($LHGRFAC_p$) Value
25>P	No Thermal Limit Monitoring Required; If official monitoring is desired, the equations for ≥25% Power may be extrapolated for 25>P.
25≤P≤100	$LHGRFAC_p$ = 1.0+0.008(P-100)
100<P	$LHGRFAC_p$ = 1.0

P = % Rated Thermal Power

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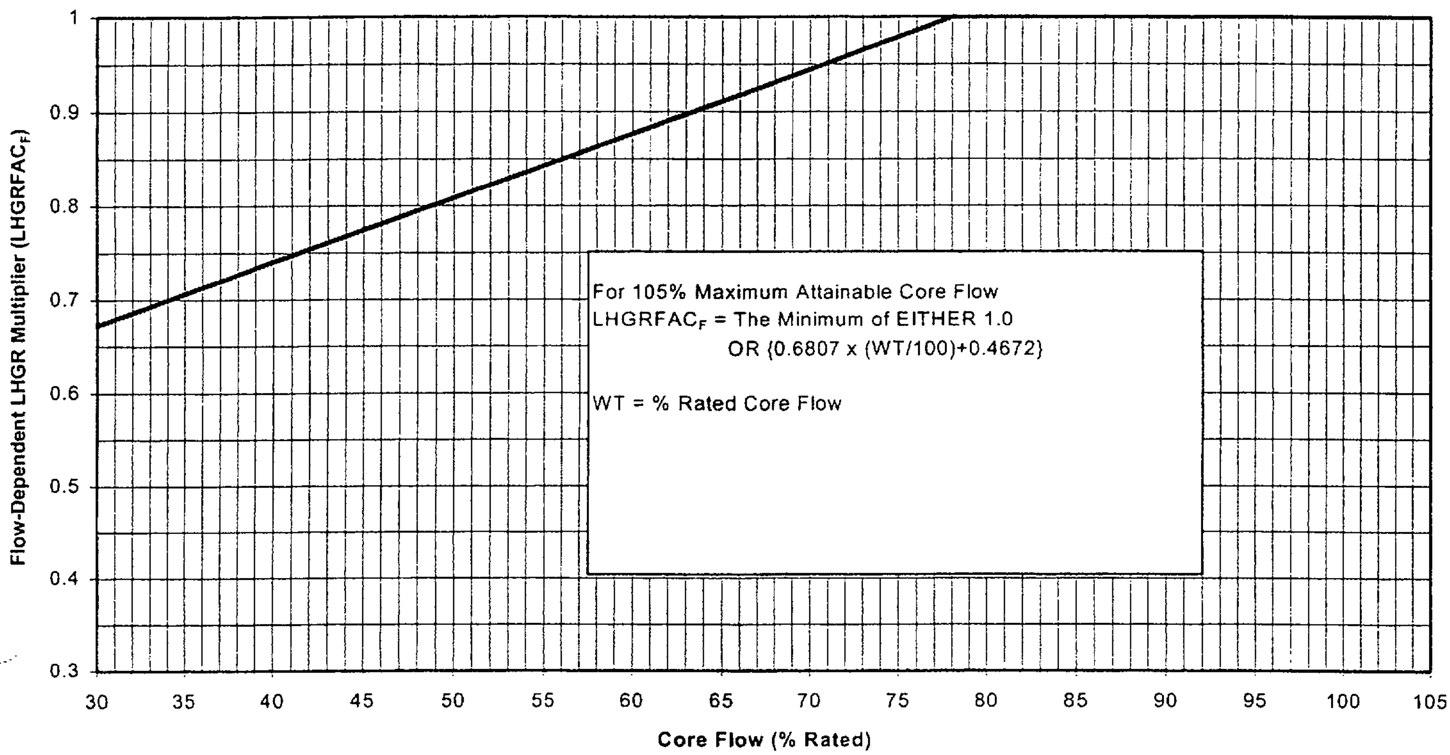
1/9/2002

LHGRFAC$_f$

Figure 1. Flow-Dependent LHGR Multiplier for GE Fuel (formerly MAPFAC$_F$)

(Reference 4, 3, and 7)



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DJF 1/9/2002

TOP/MOP Requirements for GE9 Fuel

All GE9 fuel that is being utilized in the LaSalle Unit 1 Cycle 10 reload design are located on the core periphery and therefore not in any bounding or limiting locations. Because these assemblies are in low power locations they will not challenge any margin to the MOP/TOP limits.

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Attachment 2

LaSalle Unit 1 Cycle 10A

Reload Analysis

FRAMATOME ANP

EMF-2690
Revision 0

LaSalle Unit 1 Cycle 10 Reload Analysis

January 2002

Advanced Nuclear Power

Framatome ANP, Inc.

Framatome ANP, Inc.

ISSUED IN FRA-ANP ON-LINE
DOCUMENT SYSTEM
DATE: 1/4/02

EMF-2690
Revision 0

LaSalle Unit 1 Cycle 10 Reload Analysis

Prepared:	J. M. Haun, Engineer BWR Neutronics	12/31/01 Date
Prepared:	D. G. Carr, Team Leader BWR Safety Analysis	1/2/02 Date
Concurred:	J. S. Holm, Manager Product Licensing	1/3/02 Date
Concurred:	D. E. Garber, Manager Commercial Operations	1/3/02 Date
Approved:	PDW KD Hartley for O.C.B O. C. Brown, Manager BWR Neutronics	1/2/02 Date
Approved:	Darrell G. Carr for M.E. Garrett M. E. Garrett, Manager BWR Safety Analysis	1/2/02 Date
Approved:	MJC J. R. Tandy, Manager Product Mechanical Engineering	2 Jan 02 Date
Approved:	R. E. Collingham, Manager BWR Reload Engineering & Methods Development	3 Jan 02 Date

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Nature of Changes

Item	Page	Description and Justification
1.	All	This is a new document.

Contents

Tables

Figures

Nomenclature

AOO	anticipated operational occurrence
BOC	beginning of cycle
BPWS	banked position withdrawal sequence
CRDA	control rod drop accident
CRWE	control rod withdrawal error
EFPH	effective full power hours
EOC	end of cycle
EOD	extended operating domain
EOFP	end of full power
EOOS	equipment out of service
FFTR	final feedwater temperature reduction
FHOOS	feedwater heater out of service
FRA-ANP	Framatome ANP, Inc.
FWCF	feedwater controller failure
ICA	interim corrective actions
ICF	increased core flow
LFWH	loss of feedwater heating
LHGR	linear heat generation rate
LHGRFAC	LHGR multiplier
LOCA	loss of coolant accident
LPRM	local power range monitor
LRNB	load rejection no bypass
MAPFAC	MAPLHGR multiplier
MAPLHGR	maximum average planar linear heat generation rate
MCPR	minimum critical power ratio
MELLLA	maximum extended load line limit analysis
MSIV	main steam isolation valve
NRC	Nuclear Regulatory Commission, U.S.
NSS	nominal scram speed
PAPT	protection against power transient
PCT	peak clad temperature
RPT	recirculation pump trip
SLMCPR	safety limit minimum critical power ratio
SLO	single-loop operation
SRVOOS	safety/relief valve out of service

TBVOOS	turbine bypass valves out of service
TCV	turbine control valve
TIP	traversing in-core probe
TIPOOS	traversing in-core probe out of service
TSSS	technical specification scram speed
UFSAR	updated final safety analysis report
ΔCPR	change in critical power ratio

1.0 Introduction

This report provides the results of the analysis performed by Framatome ANP, Inc. (FRA-ANP), as part of the reload analysis in support of the Cycle 10 reload for LaSalle Unit 1. This report is intended to be used in conjunction with the FRA-ANP topical Report XN-NF-80-19(P)(A), Volume 4, Revision 1, *Application of the ENC Methodology to BWR Reloads*, which describes the analyses performed in support of this reload, identifies the methodology used for those analyses, and provides a generic reference list. Section numbers in this report are the same as corresponding section numbers in XN-NF-80-19(P)(A), Volume 4, Revision 1. Methodology used in this report which supersedes XN-NF-80-19(P)(A), Volume 4, Revision 1, is referenced in Section 8.0. The NRC Technical Limitations presented in the methodology documents, including the documents referenced in Section 8.0, have been satisfied by these analyses.

The Cycle 10 core consists of a total of 764 fuel assemblies, including 346 unirradiated ATRIUM™-10* assemblies, 372 irradiated ATRIUM™-9B assemblies and 46 irradiated GE9 assemblies. The reference core configuration is described in Section 4.2.

The design and safety analyses reported in this document were based on the design and operational assumptions in effect for LaSalle Unit 1 during the previous operating cycle. The effects of channel bow are explicitly accounted for in the safety limit analysis. The extended operating domain (EOD) and equipment out of service (EOOS) conditions presented in Table 1.1 are supported.

* ATRIUM is a trademark of Framatome ANP, Inc.

Table 1.1 EOD and EOOS Operating Conditions

Extended Operating Domain (EOD) Conditions

- Increased Core Flow
- Maximum Extended Load Line Limit Analysis (MELLLA)

Equipment Out of Service (EOOS) Conditions*

- Feedwater Heaters Out of Service (FHOOS)
- Single-Loop Operation (SLO) - Recirculation Loop Out of Service
- Turbine Bypass Valves Out of Service (TBVOOS)
- EOC Recirculation Pump Trip Out of Service (No RPT)
- Turbine Control Valve (TCV) Slow Closure and/or No RPT
- Safety Relief Valve Out of Service (SRVOOS)
- Up to 2 TIP Machine(s) Out of Service or the Equivalent Number (42% of the total number of channels) of TIP Channels (100% available at startup)
- Up to 50% of the LPRMs Out of Service
- TCV Slow Closure, FHOOS and/or No RPT
- 1 Stuck Closed Turbine Control Valve

---

* EOOS conditions are supported for EOD conditions as well as the standard operating domain. Each EOOS condition combined with 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), 1 stuck closed turbine control valve and/or up to 50% of the LPRMs out of service is supported.

2.0 Fuel Mechanical Design Analysis

Applicable FRA-ANP Fuel Design Reports References 9.2, 9.3, and 9.14

To assure that the power history for the ATRIUM-10 and ATRIUM-9B fuel to be irradiated during Cycle 10 of LaSalle Unit 1 is bounded by the assumed power history in the fuel mechanical design analyses, LHGR operating limits have been specified in Section 7.2.3. In addition, ATRIUM-10 and ATRIUM-9B LHGR limits for Anticipated Operational Occurrences have been specified in References 9.2 and 9.14 and are presented in Section 7.2.3.

GE9 Fuel Mechanical Design Limits will be furnished by Exelon.

3.0 Thermal-Hydraulic Design Analysis

3.2 *Hydraulic Characterization*

3.2.1 Hydraulic Compatibility

Component hydraulic resistances for the fuel types in the LaSalle Unit 1 Cycle 10 core have been determined in single-phase flow tests of full-scale assemblies. The hydraulic demand curves for ATRIUM-10 and ATRIUM-9B fuel in the LaSalle Unit 1 core are provided in Reference 9.2 Figures 4.2 and 4.3.

3.2.3 Fuel Centerline Temperature

Applicable Reports	
ATRIUM-10	Reference 9.2, Figure 3.2
ATRIUM-9B	Reference 9.3, Figure 3.3

3.2.5 Bypass Flow

Calculated Bypass Flow at 100%P/100%F (includes water channel flow)	13.7 Mlbm/hr	Reference 9.4

3.3 *MCPR Fuel Cladding Integrity Safety Limit (SLMCPR)*

Two-Loop Operation*	1.11	Reference 9.4
Single-Loop Operation*	1.12	

3.3.1 Coolant Thermodynamic Condition

Thermal Power (at SLMCPR)	5446.6 MWt
Feedwater Flow Rate (at SLMCPR)	23.6 Mlbm/hr
Core Exit Pressure (at Rated Conditions)	1031.35 psia
Feedwater Temperature	426.5°F

* Includes the effects of channel bow, up to 2 TIPOOS (or the equivalent number of TIP channels), a 2500 EFPH LPRM calibration interval, cycle startup with uncalibrated LPRMs (BOC to 500 MWd/MTU), and up to 50% of the LPRMs out of service.

3.3.2 Design Basis Radial Power Distribution

Figure 3.1 shows the radial power distribution used in the MCPR Fuel Cladding Integrity Safety Limit analysis.

3.3.3 Design Basis Local Power Distribution

Figures 3.2 and 3.3 show the ATRIUM-10 local power peaking factors used in the MCPR Fuel Cladding Integrity Safety Limit analysis.

A10-4039B-15GV75	Figure 3.2
A10-4037B-16GV75	Figure 3.3

3.4 *Licensing Power and Exposure Shape*

The licensing axial power profile used by FRA-ANP for the plant transient analyses bounds the projected end of full power (EOFP) axial power profile. The conservative licensing axial power profile as well as the corresponding axial exposure ratio are given in Table 3.1. Future projected Cycle 10 power profiles are considered to be in compliance when the EOFP normalized power generated in the core is greater than the licensing axial power profile at the given state conditions when the comparison is made over the bottom third of the core height.

Table 3.1 Licensing Basis Core Average Axial Power Profile and Licensing Axial Power Ratio

State Conditions for Power Shape Evaluation	
Power, MWt	3489.00
Core Pressure, psia	1020.00
Inlet Subcooling, Btu/lbm	18.35
Flow, Mlb/hr	108.50
Control State	ARO

Licensing Axial Power Profile

Node	Power
Top 25	0.199
24	0.387
23	0.883
22	1.132
21	1.351
20	1.507
19	1.597
18	1.630
17	1.613
16	1.632
15	1.560
14	1.478
13	1.388
12	1.295
11	1.198
10	1.094
9	0.982
8	0.864
7	0.745
6	0.634
5	0.536
4	0.461
3	0.405
2	0.331
Bottom 1	0.098

Licensing Axial Power Ratio (EOFP, ARO)
Average Bottom 8 ft / 12 ft = 1.1335

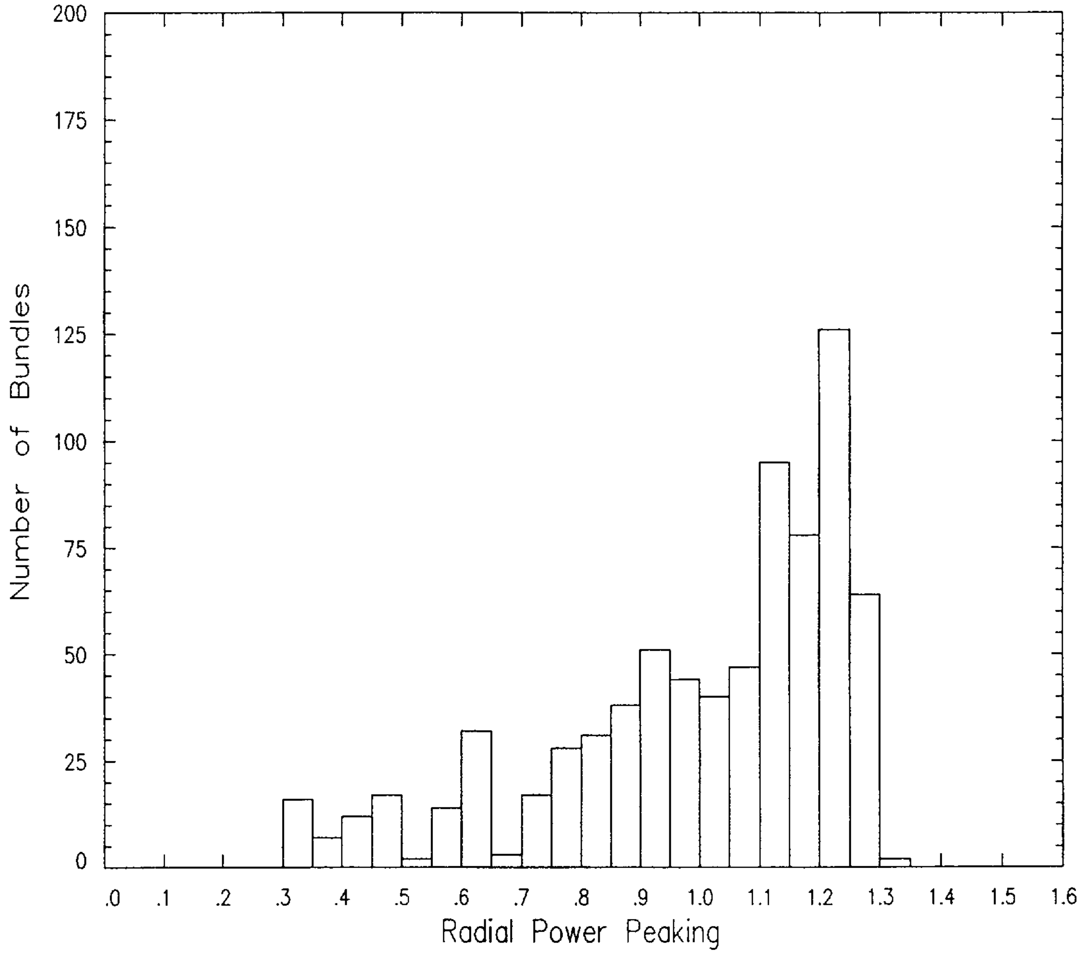


Figure 3.1 Radial Power Distribution for SLMCPR Determination

CONTROL ROD CORNER

CONTROL ROD CORNER

1.057	1.212	1.130	1.268	1.225	1.252	1.226	1.234	1.172	1.013
1.212	.000	0.540	1.036	.000	0.512	0.971	0.536	.000	1.156
1.130	0.540	0.901	.0.904	0.499	0.892	0.948	0.920	0.538	1.214
1.268	1.036	0.904	0.924	1.058	1.151	1.121	1.003	0.999	1.134
1.225	.000	0.499	1.058				1.114	0.529	1.248
1.252	0.512	0.892	1.151		Internal Water Channel		1.203	.000	1.152
1.226	0.971	0.948	1.121				1.066	0.541	1.167
1.234	0.536	0.920	1.003	1.114	1.203	1.066	0.534	1.162	1.151
1.172	.000	0.538	0.999	0.529	.000	0.541	1.162	.000	1.084
1.013	1.156	1.214	1.134	1.248	1.152	1.167	1.151	1.084	1.022

Figure 3.2 LaSalle Unit 1 Cycle 10 Safety Limit Local Peaking Factors A10-4039B-15GV75 With Channel Bow (Assembly Exposure of 1000 MWd/MTU)

CONTROL ROD CORNER

CONTROL ROD CORNER

1.061	1.225	1.141	1.282	1.240	1.271	1.246	1.255	1.191	1.021
1.225	.000	0.526	1.030	.000	0.504	0.983	0.528	.000	1.176
1.141	0.526	0.868	0.844	0.487	0.891	0.955	0.928	0.530	1.238
1.282	1.030	0.844	0.482	1.003	1.143	1.127	1.014	1.013	1.155
1.240	.000	0.487	1.003				1.126	0.522	1.273
1.271	0.504	0.891	1.143		Internal Water Channel		1.217	.000	1.173
1.246	0.983	0.955	1.127				1.076	0.533	1.189
1.255	0.528	0.928	1.014	1.126	1.217	1.076	0.527	1.183	1.173
1.191	.000	0.530	1.013	0.522	.000	0.533	1.183	.000	1.103
1.021	1.176	1.238	1.155	1.273	1.173	1.189	1.173	1.103	1.033

Figure 3.3 LaSalle Unit 1 Cycle 10 Safety Limit Local Peaking Factors A10-4037B-16GV75 With Channel Bow (Assembly Exposure of 500 MWd/MTU)

4.0 Nuclear Design Analysis

4.1 *Fuel Bundle Nuclear Design Analysis*

The detailed fuel bundle design information for the fresh ATRIUM™-10 fuel to be loaded in LaSalle Unit 1 Cycle 10 is provided in Reference 9.1. The following summary provides the appropriate cross-references.

Assembly Average Enrichment (ATRIUM-10 fuel)

A10-4039B-15GV75-100M	(FT10)	4.039 wt%
A10-4037B-16GV75-100M	(FT11)	4.037 wt%

Radial Enrichment Distribution

A10T-4307L-15G65	Reference 9.1, Figure D.3
A10B-4510L-13G75	Reference 9.1, Figure D.2
A10B-4504L-15G75	Reference 9.1, Figure D.1
A10T-4306L-16G65	Reference 9.1, Figure D.6
A10T-4305L-16G75	Reference 9.1, Figure D.9
A10B-4507L-15G75	Reference 9.1, Figure D.8
A10B-4504L-16G75	Reference 9.1, Figure D.5

Axial Enrichment Distribution	Reference 9.1, Figures 2.1–2.2
Burnable Absorber Distribution	Reference 9.1, Figures 2.3–2.5
Non-Fueled Rods	Reference 9.1, Figures 2.3–2.4
Neutronic Design Parameters	Table 4.1

Fuel Storage

LaSalle New Fuel Storage Vault — Reference 9.5

The LSA-2 Reload Batch fuel designs meet the fuel design limitations defined in Table 2.1 of Reference 9.5 and therefore can be safely stored in the vault.

LaSalle Unit 1 Spent Fuel Storage Pool (BORAL Racks) — Reference 9.6

The LSA-2 Reload Batch fuel designs meet the fuel design limitations defined in Table 2.1 of Reference 9.6 and therefore can be safely stored in the pool.

LaSalle Unit 2 Spent Fuel Storage Pool (Boraflex Racks) — Reference 9.7

The LSA-2 Reload Batch fuel designs can be safely stored as long as the fuel assembly reactivity limitations defined in Reference 9.7 are met.

4.2 *Core Nuclear Design Analysis*

4.2.1 Core Configuration

Figure 4.1

Core Exposure at EOC9, MWd/MTU (nominal value)	30498.7
Core Exposure at BOC10, MWd/MT (from nominal EOC9)	12896.0
Core Exposure at EOC10, MWd/MTU (licensing basis to EOFP)	31495.1
Core Exposure at EOC9, MWd/MTU (short window)	29998.6

Note: Analyses in this report are applicable for EOFP up to a core exposure of 31495.1 MWd/MTU.

4.2.2 Core Reactivity Characteristics for Short EOC9 Window

Cold SDM values to be provided by Exelon.

Standby boron liquid control system (SLCS) reactivity, with 1571 ppm equivalent boron:

Cold conditions, bias adjusted k-eff (max.)	0.89416
Shutdown margin, (%Δk)	10.5

Note: LaSalle SLCS has B10 enriched to 45%. The SLCS analysis assumes 1571 ppm boron which is equivalent to 660 ppm with boron enriched to 45% B-10.

4.2.4 Core Hydrodynamic Stability

Reference 8.8 and 9.15

LaSalle Unit 1 utilizes the BWROG Interim Corrective Actions (ICAs) to address thermal hydraulic instability issues. This is in response to Generic Letter 94-02. When the long term solution OPRM is fully implemented, the ICAs will remain as a backup to the OPRM system.

In order to support the ICAs and remain cognizant of the relative stability of one cycle compared with previous cycles, decay ratios are calculated at various points on the power to flow map and at various points in the cycle. This satisfies the following functions:

- Provides trending information to qualitatively compare the stability from cycle to cycle.
- Provides decay ratio sensitivities to rod line and flow changes near the ICA regions.
- Allows Exelon to review this information to determine if any administrative conservatisms are appropriate beyond the existing requirements.

The NRC approved STAIF computer code was used in the core hydrodynamic stability analysis performed in support of LaSalle Unit 1 Cycle 10. The power/flow state points used for this analysis were chosen to assist Exelon in performing the three functions described above. The Cycle 10 licensing basis control rod step-through projection was used to establish expected core depletion conditions. For each power/flow point, decay ratios were calculated at multiple cycle exposures to determine the highest expected decay ratio throughout the cycle. The results from this analysis are shown below.

Power* (%)	Flow (%)	Global	Regional
31.6	31.5	0.44	0.37
40.1	45.0	0.25	0.22
61.9	45.0	0.67	0.63
65.9	50.0	0.56	0.51
69.9	55.0	0.48	0.42
73.6	50.0	0.75	0.68
74.9	55.0	0.58	0.50
78.1	55.0	0.61	0.55
78.2	60.0	0.51	0.41
82.4	60.0	0.53	0.47

For reactor operation under conditions of power coastdown, single-loop operation, final feedwater temperature reduction (FFTR) and/or operation with feedwater heaters out of service, it is possible that higher decay ratios could be achieved than are shown for normal operation.

* Note: % power is based on 3489 MWt as rated. % flow is based on 108.5 Mlb/hr as rated.

Table 4.1 Neutronic Design Values

Number of Fuel Assemblies	764
Rated Thermal Power, MWt	3489
Rated Core Flow, Mlbm/hr	108.5
Core Inlet Subcooling, Btu/lbm	18.35
Moderator Temperature, °F	548.8
Channel Thickness, inch	0.100
Fuel Assembly Pitch, inch	6.0
Wide Water Gap Thickness, inch	0.261
Narrow Water Gap Thickness, inch	0.261
Control Rod Data*	
Absorber Material	B_4C
Total Blade Support Span, inch	1.580
Blade Thickness, inch	0.260
Blade Face-to-Face Internal Dimension, inch	0.200
Absorber Rod OD, inch	0.188
Absorber Rod ID, inch	0.138
Percentage B_4C, %TD	70

* The control rod data represents original equipment control blades at LaSalle and were used in the neutronic calculations.

I: \ J:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1									5	5	6	7	7	6	7	7	6	7	7	6	6	5								
2								4	6	10	9	10	8	10	9	9	10	8	10	9	10	6	5							
3						4	5	8	10	6	10	11	10	11	10	10	11	10	11	10	6	10	8	5	4					
4						5	6	10	9	10	9	10	8	10	6	6	10	8	10	9	10	9	10	6	5					
5					5	6	10	11	10	7	10	6	10	7	10	10	7	10	6	10	7	10	11	10	6	5				
6			4	5	6	8	6	10	6	10	7	10	7	10	6	6	10	7	10	7	10	6	10	6	8	6	5	4		
7			5	6	10	6	10	6	10	7	10	6	10	6	10	10	6	10	6	10	7	10	6	10	6	10	6	5		
8		4	8	10	11	10	6	10	8	10	6	11	9	10	6	6	10	9	11	6	10	8	10	6	10	11	10	8	4	
9	5	6	10	9	10	6	10	8	10	6	10	7	11	6	10	10	6	11	7	10	6	10	8	10	6	10	9	10	6	5
10	6	10	6	10	7	10	7	10	6	10	7	11	6	10	6	6	10	6	11	7	10	6	10	7	10	7	10	6	10	6
11	6	9	10	9	10	7	10	6	10	7	10	6	10	7	10	10	7	10	6	10	7	10	6	10	7	10	9	10	9	6
12	7	10	11	10	6	10	6	11	7	11	6	10	6	10	6	6	10	6	10	6	11	7	11	6	10	6	10	11	10	7
13	7	8	10	8	10	7	10	9	11	6	10	6	10	6	10	10	6	10	6	10	6	11	9	10	7	10	8	10	8	7
14	6	10	11	10	7	10	6	10	6	10	7	10	6	10	6	6	10	6	10	7	10	6	10	6	10	7	10	11	10	6
15	7	9	10	6	10	6	10	6	10	6	10	6	10	6	6	11	6	10	6	10	6	10	6	10	6	10	6	10	9	7
16	7	9	10	6	10	6	10	6	10	6	10	6	10	6	11	6	6	10	6	10	6	10	6	10	6	10	6	10	9	7
17	6	10	11	10	7	10	6	10	6	10	7	10	6	10	6	6	10	6	10	7	10	6	10	6	10	7	10	11	10	6
18	7	8	10	8	10	7	10	9	11	6	10	6	10	6	10	10	6	10	6	10	6	11	9	10	7	10	8	10	8	7
19	7	10	11	10	6	10	6	11	7	11	6	10	6	10	6	6	10	6	10	6	11	7	11	6	10	6	10	11	10	7
20	6	9	10	9	10	7	10	6	10	7	10	6	10	7	10	10	7	10	6	10	7	10	6	10	7	10	9	10	9	6
21	6	10	6	10	7	10	7	10	6	10	7	11	6	10	6	6	10	6	11	7	10	6	10	7	10	7	10	6	10	6
22	5	6	10	9	10	6	10	8	10	6	10	7	11	6	10	10	6	11	7	10	6	10	8	10	6	10	9	10	6	5
23		5	8	10	11	10	6	10	8	10	6	11	9	10	6	6	10	9	11	6	10	8	10	6	10	11	10	8	4	
24			5	6	10	6	10	6	10	7	10	6	10	6	10	10	6	10	6	10	7	10	6	10	6	10	6	5		
25			4	5	6	8	6	10	6	10	7	10	7	10	6	6	10	7	10	7	10	6	10	6	8	6	5	4		
26					5	6	10	11	10	7	10	6	10	7	10	10	7	10	6	10	7	10	11	10	6	5				
27						5	6	10	9	10	9	10	8	10	6	6	10	8	10	9	10	9	10	6	5					
28						4	5	8	10	6	10	11	10	11	10	10	11	10	11	10	6	10	8	5	4					
29								5	6	10	9	10	8	10	9	9	10	8	10	9	10	6	4							
30									5	6	6	7	7	6	7	7	6	7	7	6	5	5								

Fuel Type	Bundle Name	Number of Bundles	ID Range	Load Cycle
4	GE9B-P8CWB343-12GZ-80M-150	13	YJD661-YJD764	8
5	GE9B-P8CWB342-10GZ-80M-150	33	YJD517-YJD660	8
6	SPCA9-393B-16GZ-100M	208	19A001-19A208	9
7	SPCA9-396B-12GZB-100M	88	19B209-19B296	9
8	SPCA9-384B-11GZ-80M	36	28B257-28B292	9
9	SPCA9-396B-12GZC-100M	40	19C297-19C336	9
10	A10-4039B-15GV75	296	30A001-30A296	10
11	A10-4037B-16GV75	50	30B297-30B346	10

Figure 4.1 LaSalle Unit 1 Cycle 10 Reference Loading Map

5.0 Anticipated Operational Occurrences

Applicable Disposition of Events — Reference 9.8

5.1 *Analysis of Plant Transients at Rated Conditions* — Reference 9.4

Limiting Transients:
Load Rejection No Bypass (LRNB)
Feedwater Controller Failure (FWCF)
Loss of Feedwater Heating (LFWH)
Control Rod Withdrawal Error (CRWE)

5.1.1 15,000 MWd/MTU Cycle Exposure

Transient	Scram Speed	Peak Neutron Flux (% Rated)	Peak Heat Flux (% Rated)	Peak Lower Plenum Pressure (psig)	ΔCPR ATRIUM-10/ ATRIUM-9B
LRNB*	TSSS	415	122	1203	0.35/0.33
FWCF*	TSSS	342	122	1166	0.33/0.30
LRNB*	NSS	306	120	1196	0.32/0.31
FWCF*	NSS	266	117	1160	0.29/0.25
LFWH		--	--	--	0.21/0.21
CRWE		--	--	--	0.19/0.19

5.1.2 EOC Licensing Exposure

Transient	Scram Speed	Peak Neutron Flux (% Rated)	Peak Heat Flux (% Rated)	Peak Lower Plenum Pressure (psig)	ΔCPR ATRIUM-10 /ATRIUM-9B
LRNB†	TSSS	516	135	1216	0.39/0.33
FWCF*	TSSS	395	128	1177	0.33‡/0.30‡
LRNB†	NSS	513	132	1207	0.36/0.32
FWCF*	NSS	366	126	1168	0.29/0.27
LFWH		--	--	--	0.21/0.21
CRWE		--	--	--	0.19/0.19

* Based on 100%P/105%F conditions.

† Based on 100%P/81%F conditions.

‡ The analysis results are from an earlier exposure in this cycle.

5.2 *Analysis for Reduced Flow Operation* Reference 9.4

Limiting Transient: Slow Flow Excursion

$MCPR_f$ Manual Flow Control ATRIUM-10 and ATRIUM-9B Fuel	Figure 5.1
$LHGRFAC_f$ ATRIUM-10 and ATRIUM-9B Fuel	Figure 5.2

$MCPR_f$ and $LHGRFAC_f$ results are applicable at all Cycle 10 exposures and in all EOD and EOOS scenarios presented in Table 1.1.

5.3 *Analysis for Reduced Power Operation* Reference 9.4

Limiting Transient: Load Rejection No Bypass (LRNB)
Feedwater Controller Failure (FWCF)

$MCPR_p$ Base Case Operation Figures 5.3–5.10	Tables 5.1–5.4
$LHGRFAC_p$ Base Case Operation*	Tables 5.1–5.4
$MCPR_p$, EOOS Conditions	Tables 5.1–5.4
$LHGRFAC_p$, EOOS Conditions*	Tables 5.1–5.4
$MAPFAC_p$ — All Operating Conditions*	<To be furnished by Exelon.>

5.4 *ASME Overpressurization Analysis* Reference 9.4

Limiting Event	MSIV Closure
Worst Single Failure	Valve Position Scram
Maximum Vessel Pressure (Lower Plenum)	1346 psig
Maximum Steam Dome Pressure	1321 psig

5.5 *Control Rod Withdrawal Error*

The control rod withdrawal error event is analyzed at rated conditions, assuming no xenon and unblocked conditions. The analysis further assumes that the plant is operating in the A2 or A1 rod sequence. The results bound low power operation.

The limiting ΔCPR for the CRWE analysis is 0.19.

* $LHGRFAC_p$ values presented are applicable to FRA-ANP fuel. GE $MAPFAC_p$ limits will continue to be applied to GE9 fuel at off-rated power.

The core design complies with FRA-ANP's 1% plastic strain and centerline melt criteria via conformance to the PAPT (Protection Against Power Transient) LHGR limit.

5.6 *Fuel Loading Error*

5.6.1 Mislocated Fuel Assembly

FRA-ANP has performed fuel mislocation error analyses for LaSalle Unit 1 Cycle 10. Based on these analyses, the offsite dose criteria (a small fraction of 10 CFR 100) is conservatively satisfied.

5.6.2 Misoriented Fuel Bundle

FRA-ANP has performed a bounding fuel misorientation analysis, which includes cores that load ATRIUM-9B and ATRIUM-10 fuel assemblies. The analyses were performed assuming the limiting assembly was loaded in the worst orientation (rotated 180°) while producing sufficient power to be on the MCPR limit if it had been oriented correctly. The analyses demonstrate that the small fraction of 10 CFR 100 offsite dose criteria is conservatively satisfied.

5.7 *Determination of Thermal Margins*

The results of the analyses presented in Sections 5.1–5.3 are used for the determination of the operating limit. Section 5.1 provides the results of analyses at rated conditions. Section 5.2 provides for the determination of the MCPR and LHGR limits at reduced flow ($MCPR_f$, Figure 5.1; $LHGRFAC_f$, Figure 5.2). Section 5.3 provides for the determination of the MCPR and LHGR limits at conditions of reduced power (Figures 5.3–5.10, Tables 5.1–5.4). Exposure dependent limits are presented for base case operation and the EOD and EOOS scenarios presented in Table 1.1. Operating limits for the EOOS conditions are divided into three different scenarios. EOOS Case 1 limits support operation with FHOOS or with the turbine bypass valves inoperable. Case 1 limits also support operation with FHOOS and 1 stuck closed TCV. EOOS Case 2 limits support operation with any combination of TCV slow closure, no RPT or FHOOS. The Case 2 limits also support the same EOOS scenarios in combination with 1 stuck closed TCV. A third set of EOOS limits are provided to support operation with the turbine bypass valves inoperable in conjunction with 1 stuck closed TCV. Limits for single-loop operation with the same EOOS conditions are also provided.

Cycle 10 power- and flow-dependent MCPR limits are presented for both ATRIUM-10 and ATRIUM-9B fuel. Since the GE9 fuel is in low power peripheral locations for L1C10, the ATRIUM-9B MCPR limits can be used for the GE9 fuel. LHGR and MAPLHGR limits for all three fuel types are discussed in Section 7.0.

Table 5.1 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times BOC to 15,000 MWd/MTU *,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.75	2.70	0.77
	25	2.20	0.75	2.20	0.77
	25	2.07	0.75	1.95	0.77
	60	1.52	1.00	1.50	1.00
	100	1.43	1.00	1.42	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.86	0.66	2.70	0.69
	25	2.36	0.66	2.20	0.69
	25	2.36	0.66	2.15	0.69
	60	1.59	0.94	1.58	0.90
	80	--	0.94	--	0.90
	100	1.47	0.95	1.45	0.90
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.86	0.65	2.70	0.67
	25	2.36	0.65	2.20	0.67
	25	2.36	0.65	2.15	0.67
	80	1.81	0.88	1.86	0.79
	80	1.74	0.88	1.67	0.79
	100	1.54	0.89	1.52	0.79
TBVOOS with 1 stuck closed TCV	0	2.86	0.66	2.70	0.69
	25	2.36	0.66	2.20	0.69
	25	2.36	0.66	2.15	0.69
	60	1.59	0.77	1.58	0.77
	80	--	0.77	--	0.77
	100	1.47	0.83	1.45	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 5.1 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times BOC to 15,000 MWd/MTU *,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-Loop Operation‡	0	2.71	0.75	2.71	0.77
	25	2.21	0.75	2.21	0.77
	25	2.08	0.75	1.96	0.77
	60	1.53	1.00	1.51	1.00
	100	1.44	1.00	1.43	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.87	0.66	2.71	0.69
	25	2.37	0.66	2.21	0.69
	25	2.37	0.66	2.16	0.69
	60	1.60	0.94	1.59	0.90
	80	--	0.94	--	0.90
	100	1.48	0.95	1.46	0.90
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.87	0.65	2.71	0.67
	25	2.37	0.65	2.21	0.67
	25	2.37	0.65	2.16	0.67
	80	1.82	0.88	1.87	0.79
	80	1.75	0.88	1.68	0.79
	100	1.55	0.89	1.53	0.79
SLO with TBVOOS and 1 stuck closed TCV	0	2.87	0.66	2.71	0.69
	25	2.37	0.66	2.21	0.69
	25	2.37	0.66	2.16	0.69
	60	1.60	0.77	1.59	0.77
	80	--	0.77	--	0.77
	100	1.48	0.83	1.46	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 5.2 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times BOC to 15,000 MWd/MTU *,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel $MCPR_p$	ATRIUM-10 Fuel $LHGRFAC_p$	ATRIUM-9B Fuel $MCPR_p$	ATRIUM-9B Fuel $LHGRFAC_p$
Base case operation‡	0	2.70	0.74	2.70	0.76
	25	2.20	0.74	2.20	0.76
	25	2.15	0.74	1.96	0.76
	60	1.55	1.00	1.54	1.00
	100	1.46	1.00	1.44	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	60	1.62	0.94	1.62	0.89
	80	--	0.94	--	0.91
	100	1.51	0.95	1.48	0.92
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.95	0.64	2.70	0.67
	25	2.45	0.64	2.20	0.67
	25	2.45	0.64	2.19	0.67
	80	1.82	0.87	1.86	0.76
	80	1.74	0.87	1.73	0.76
	100	1.59	0.87	1.59	0.76
TBVOOS with 1 stuck closed TCV	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	40	--	0.77	--	0.77
	60	1.62	0.77	1.62	0.77
	80	--	0.77	--	0.77
	100	1.51	0.83	1.48	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 5.2 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times BOC to 15,000 MWd/MTU*,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-Loop Operation‡	0	2.71	0.74	2.71	0.76
	25	2.21	0.74	2.21	0.76
	25	2.16	0.74	1.97	0.76
	60	1.56	1.00	1.55	1.00
	100	1.47	1.00	1.45	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	60	1.63	0.94	1.63	0.89
	80	--	0.94	--	0.91
	100	1.52	0.95	1.49	0.92
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.96	0.64	2.71	0.67
	25	2.46	0.64	2.21	0.67
	25	2.46	0.64	2.20	0.67
	80	1.83	0.87	1.87	0.76
	80	1.75	0.87	1.74	0.76
	100	1.60	0.87	1.60	0.76
SLO with TBVOOS and 1 stuck closed TCV	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	40	--	0.77	--	0.77
	60	1.63	0.77	1.63	0.77
	80	--	0.77	--	0.77
	100	1.52	0.83	1.49	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 5.3 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times 15,000 MWd/MTU to EOC *,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.75	2.70	0.76
	25	2.20	0.75	2.20	0.76
	25	2.07	0.75	1.95	0.76
	60	1.52	1.00	1.50	1.00
	100	1.47	1.00	1.43	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.86	0.66	2.70	0.69
	25	2.36	0.66	2.20	0.69
	25	2.36	0.66	2.15	0.69
	60	1.59	0.94	1.58	0.90
	80	--	0.94	--	0.90
	100	1.47	0.95	1.45	0.90
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.86	0.65	2.70	0.67
	25	2.36	0.65	2.20	0.67
	25	2.36	0.65	2.15	0.67
	80	1.81	0.84	1.86	0.79
	80	1.74	0.84	1.67	0.79
	100	1.59	0.84	1.58	0.79
TBVOOS with 1 stuck closed TCV	0	2.86	0.65	2.70	0.69
	25	2.36	0.65	2.20	0.69
	25	2.36	0.65	2.15	0.69
	60	1.59	0.77	1.58	0.77
	80	--	0.77	--	0.77
	100	1.47	0.83	1.45	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 5.3 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times 15,000 MWd/MTU to EOC [*,†]
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-Loop Operation[‡]	0	2.71	0.75	2.71	0.76
	25	2.21	0.75	2.21	0.76
	25	2.08	0.75	1.96	0.76
	60	1.53	1.00	1.51	1.00
	100	1.48	1.00	1.44	1.00
SLO with EOOS Case 1 (FHOOS[‡] OR TBVOOS)	0	2.87	0.66	2.71	0.69
	25	2.37	0.66	2.21	0.69
	25	2.37	0.66	2.16	0.69
	60	1.60	0.94	1.59	0.90
	80	--	0.94	--	0.90
	100	1.48	0.95	1.46	0.90
SLO with EOOS Case 2[‡] (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.87	0.65	2.71	0.67
	25	2.37	0.65	2.21	0.67
	25	2.37	0.65	2.16	0.67
	80	1.82	0.84	1.87	0.79
	80	1.75	0.84	1.68	0.79
	100	1.60	0.84	1.59	0.79
SLO with TBVOOS and 1 stuck closed TCV	0	2.87	0.65	2.71	0.69
	25	2.37	0.65	2.21	0.69
	25	2.37	0.65	2.16	0.69
	60	1.60	0.77	1.59	0.77
	80	--	0.77	--	0.77
	100	1.48	0.83	1.46	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 5.4 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times 15,000 MWd/MTU to EOC *,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.74	2.70	0.76
	25	2.20	0.74	2.20	0.76
	25	2.15	0.74	1.96	0.76
	60	1.55	1.00	1.54	1.00
	100	1.50	1.00	1.44	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	60	1.62	0.94	1.62	0.89
	80	--	0.94	--	0.91
	100	1.51	0.95	1.48	0.92
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.95	0.64	2.70	0.67
	25	2.45	0.64	2.20	0.67
	25	2.45	0.64	2.19	0.67
	80	1.82	0.82	1.86	0.76
	80	1.74	0.82	1.73	0.76
	100	1.64	0.82	1.65	0.76
TBVOOS with 1 stuck closed TCV	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	40	--	0.77	--	0.77
	60	1.62	0.77	1.62	0.77
	80	--	0.77	--	0.77
	100	1.51	0.83	1.48	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

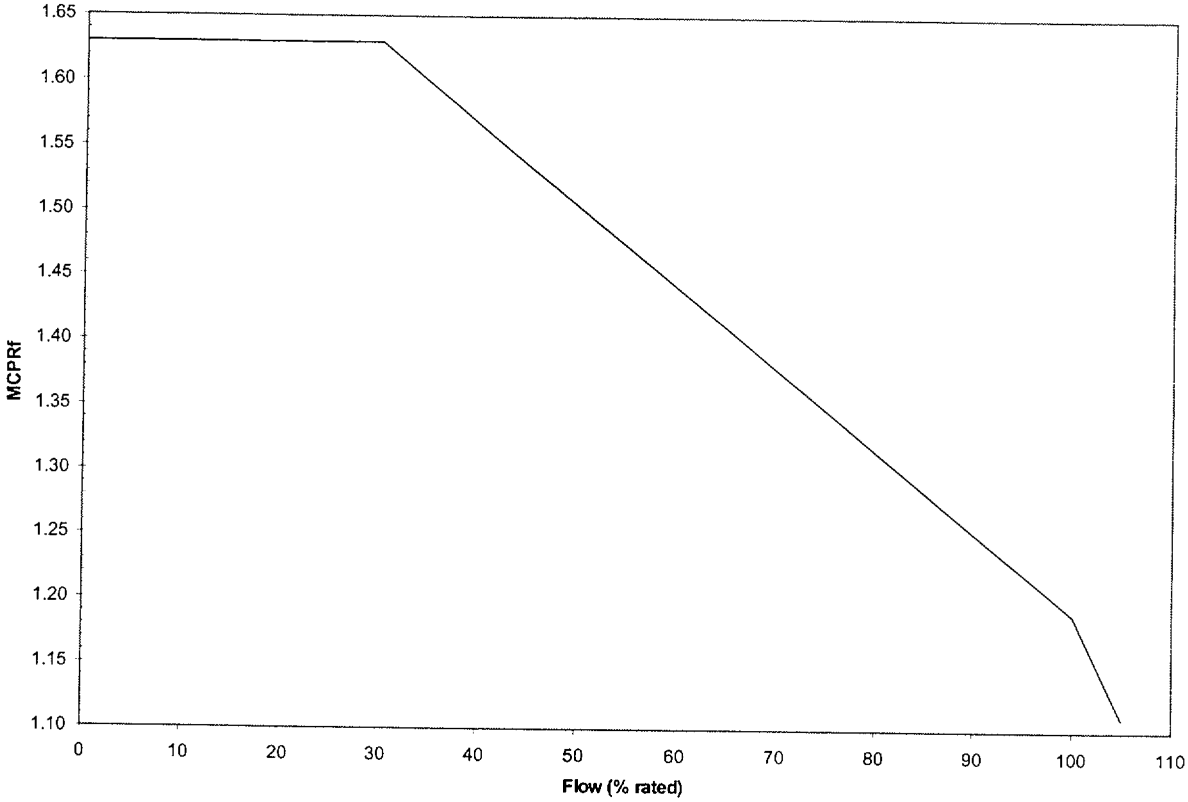
Table 5.4 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times 15,000 MWd/MTU to EOC *,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-Loop Operation‡	0	2.71	0.74	2.71	0.76
	25	2.21	0.74	2.21	0.76
	25	2.16	0.74	1.97	0.76
	60	1.56	1.00	1.55	1.00
	100	1.51	1.00	1.45	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	60	1.63	0.94	1.63	0.89
	80	--	0.94	--	0.91
	100	1.52	0.95	1.49	0.92
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.96	0.64	2.71	0.67
	25	2.46	0.64	2.21	0.67
	25	2.46	0.64	2.20	0.67
	80	1.83	0.82	1.87	0.76
	80	1.75	0.82	1.74	0.76
	100	1.65	0.82	1.66	0.76
SLO with TBVOOS and 1 stuck closed TCV	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	40	--	0.77	--	0.77
	60	1.63	0.77	1.63	0.77
	80	--	0.77	--	0.77
	100	1.52	0.83	1.49	0.80

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

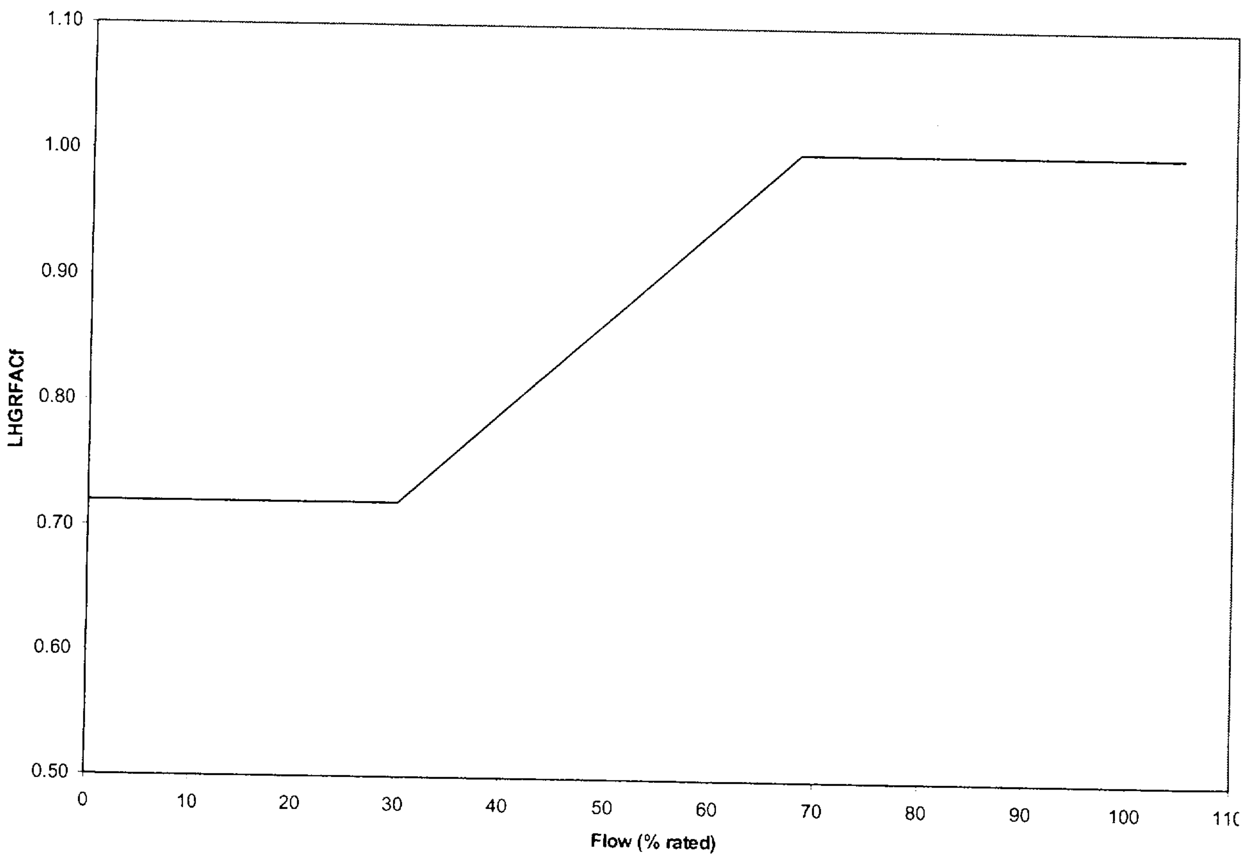
‡ With or without 1 stuck closed TCV.



Flow (% of rated)	$MCPR_f$ ATRIUM-10	$MCPR_f$ ATRIUM-9B*
0	1.63	1.63
30	1.63	1.63
100	1.19	1.19
105	1.11	1.11

Figure 5.1 Flow-Dependent MCPR Limits for Manual Flow Control Mode

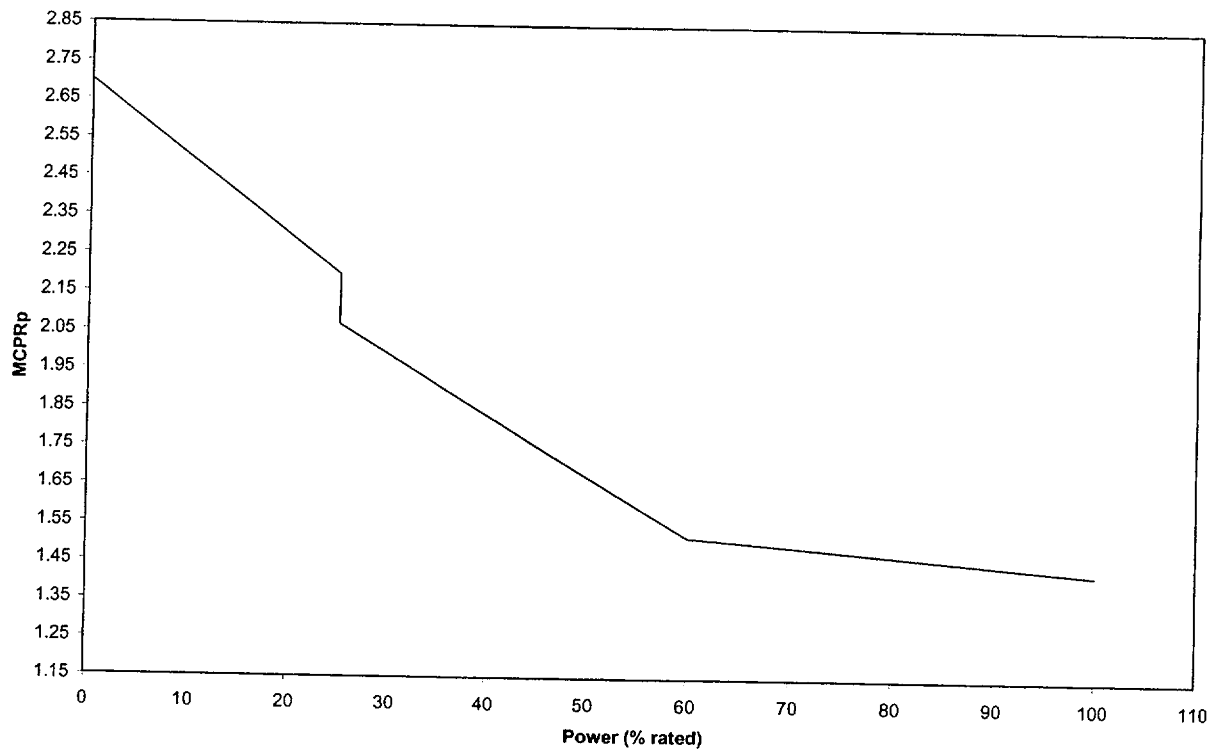
* GE9 fuel assemblies will use the ATRIUM-9B MCPR limits.



Flow (% rated)	$LHGRFAC_f$*
0	0.72
30	0.72
68	1.00
105	1.00

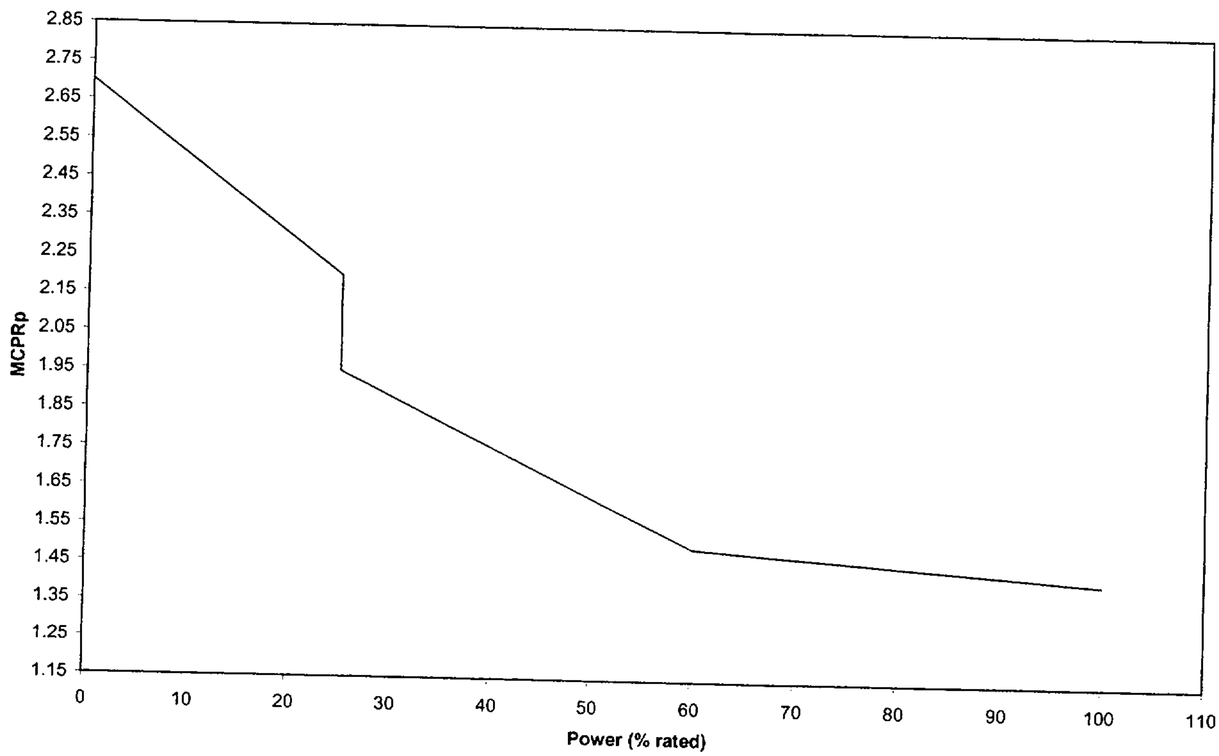
Figure 5.2 Flow Dependent LHGR Multipliers for ATRIUM-10 and ATRIUM-9B Fuel

* GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.



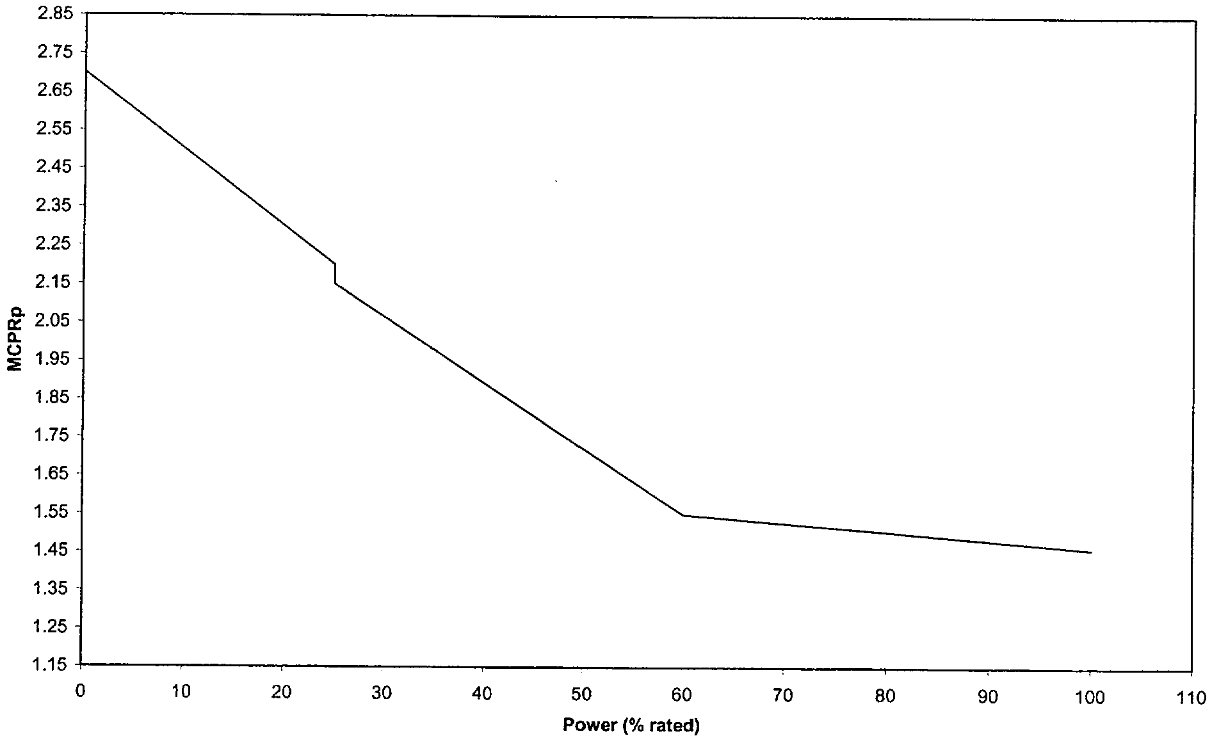
Power (%)	$MCPR_p$ Limit
100	1.43
60	1.52
25	2.07
25	2.20
0	2.70

Figure 5.3 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



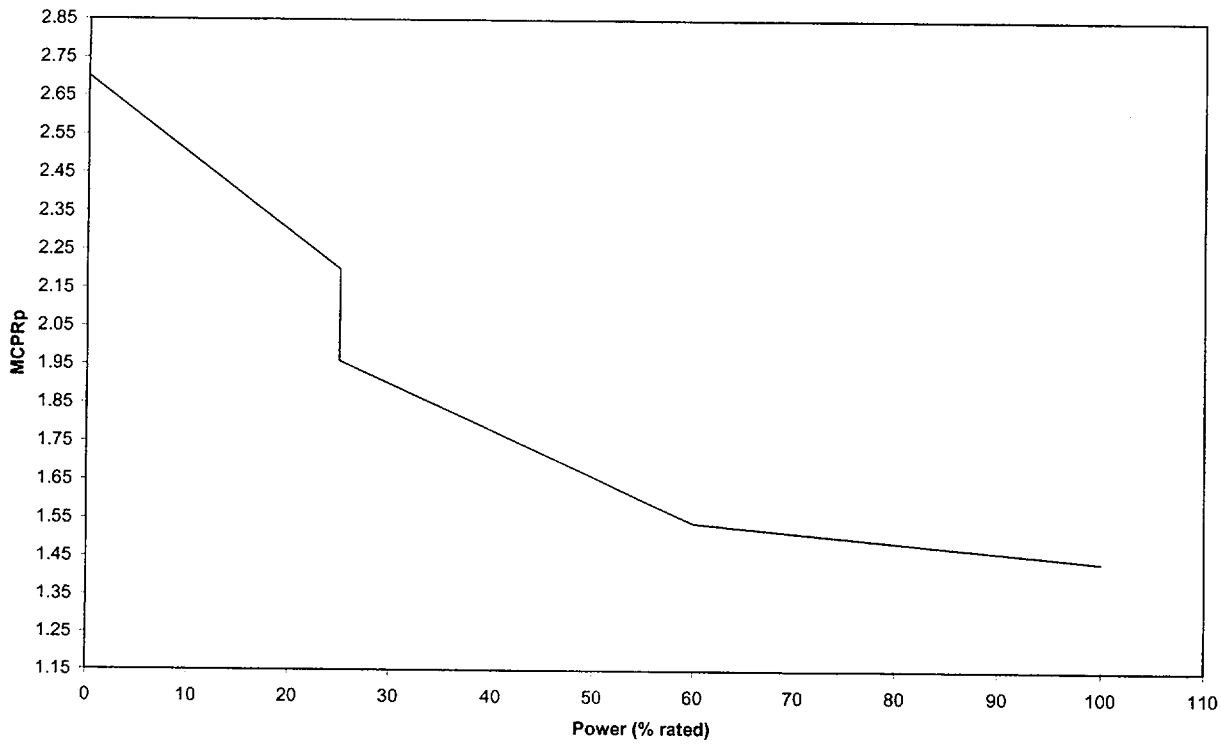
Power (%)	$MCPR_p$ Limit
100	1.42
60	1.50
25	1.95
25	2.20
0	2.70

Figure 5.4 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



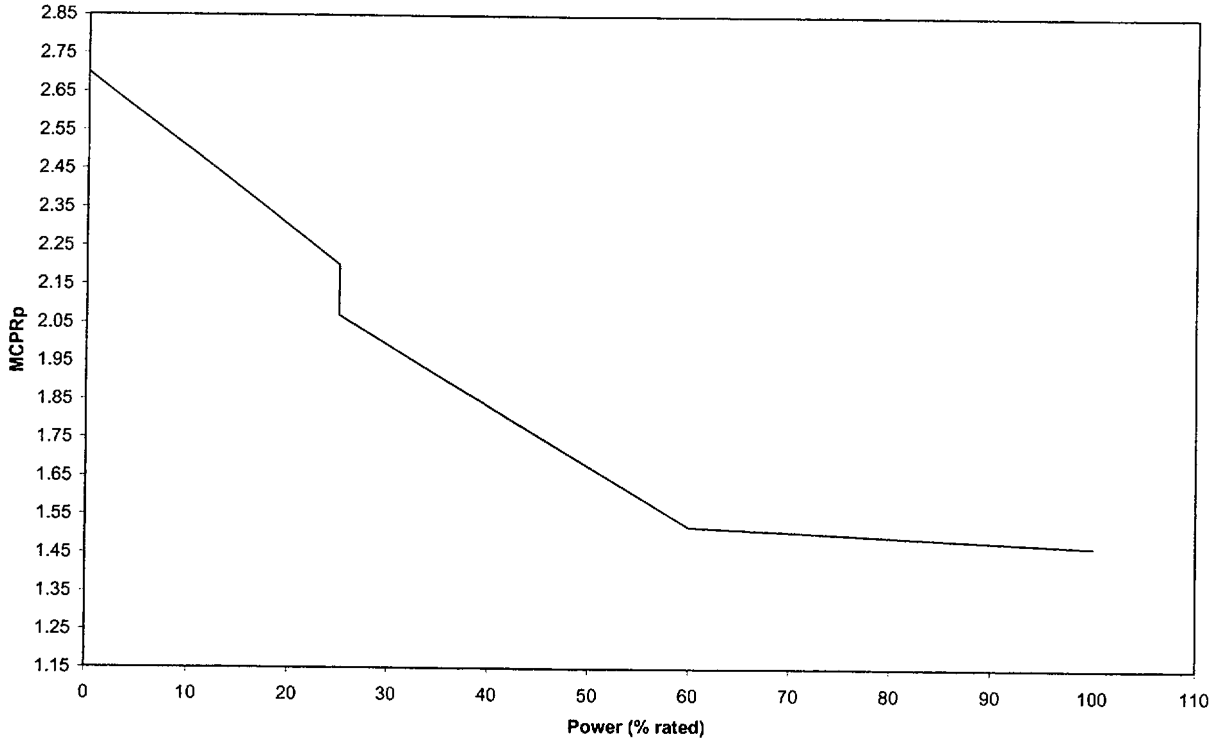
Power (%)	$MCPR_p$ Limit
100	1.46
60	1.55
25	2.15
25	2.20
0	2.70

Figure 5.5 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



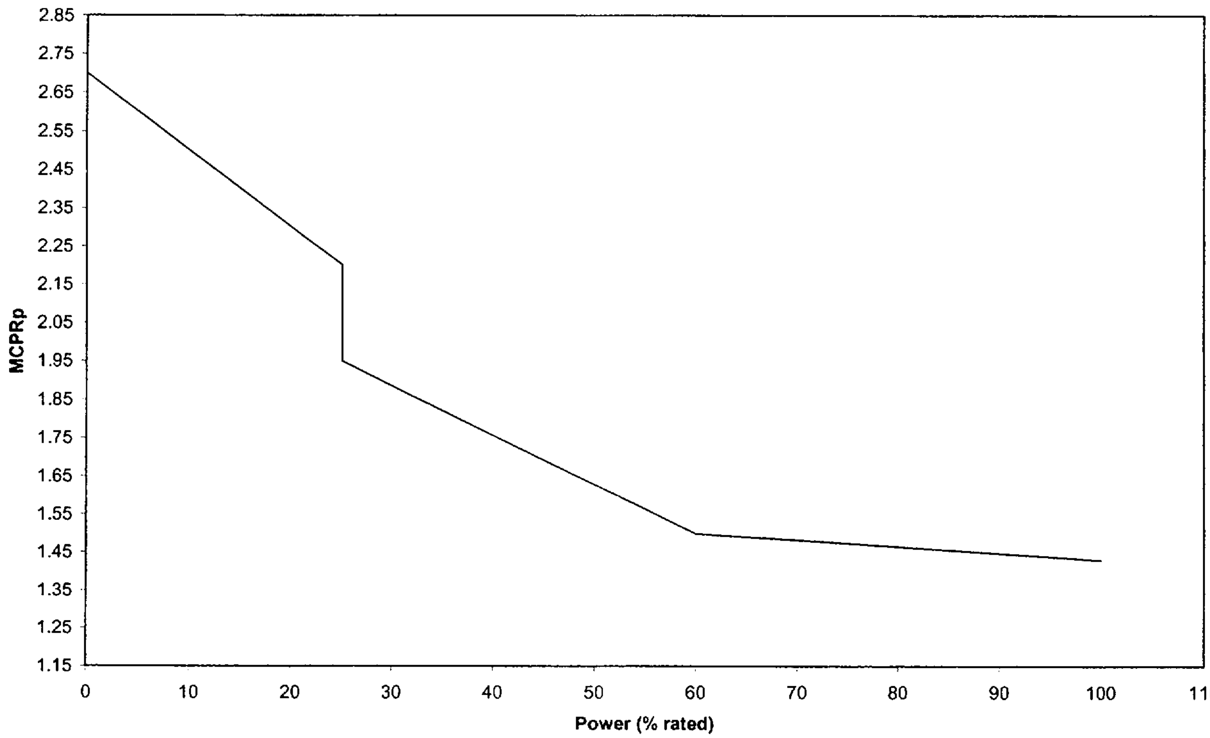
Power (%)	$MCPR_p$ Limit
100	1.44
60	1.54
25	1.96
25	2.20
0	2.70

Figure 5.6 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



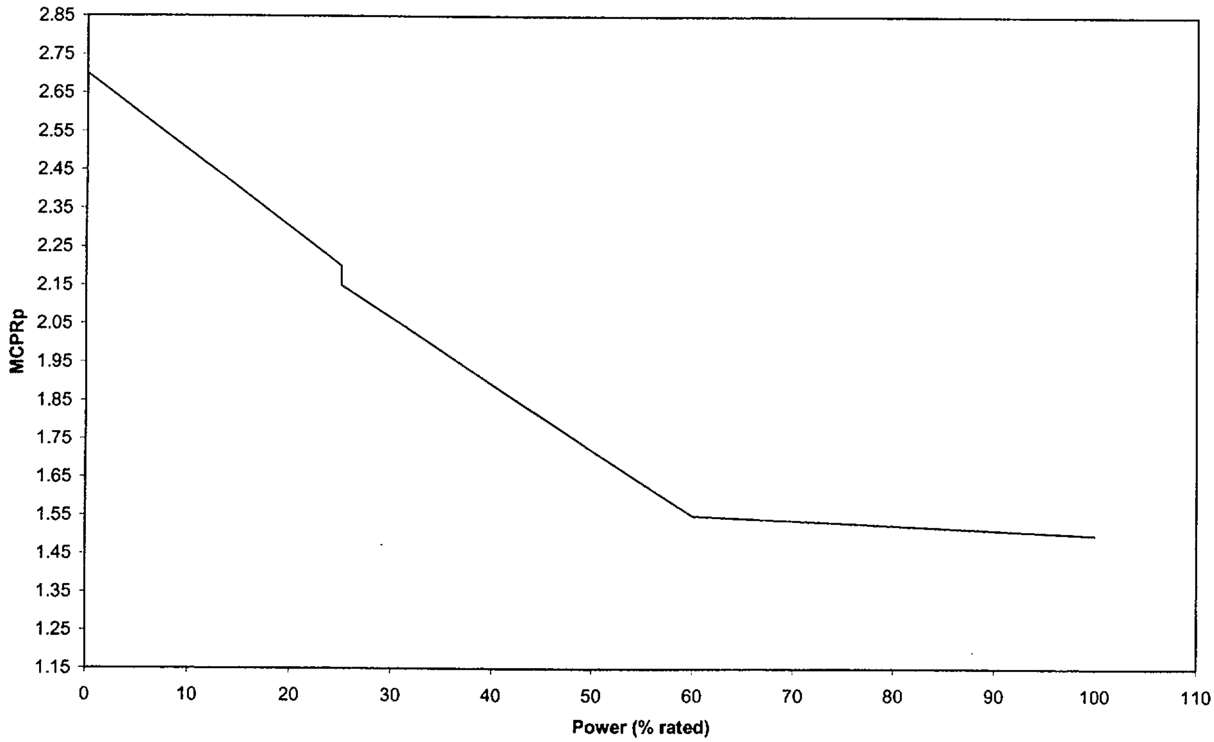
Power (%)	$MCPR_p$ Limit
100	1.47
60	1.52
25	2.07
25	2.20
0	2.70

Figure 5.7 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



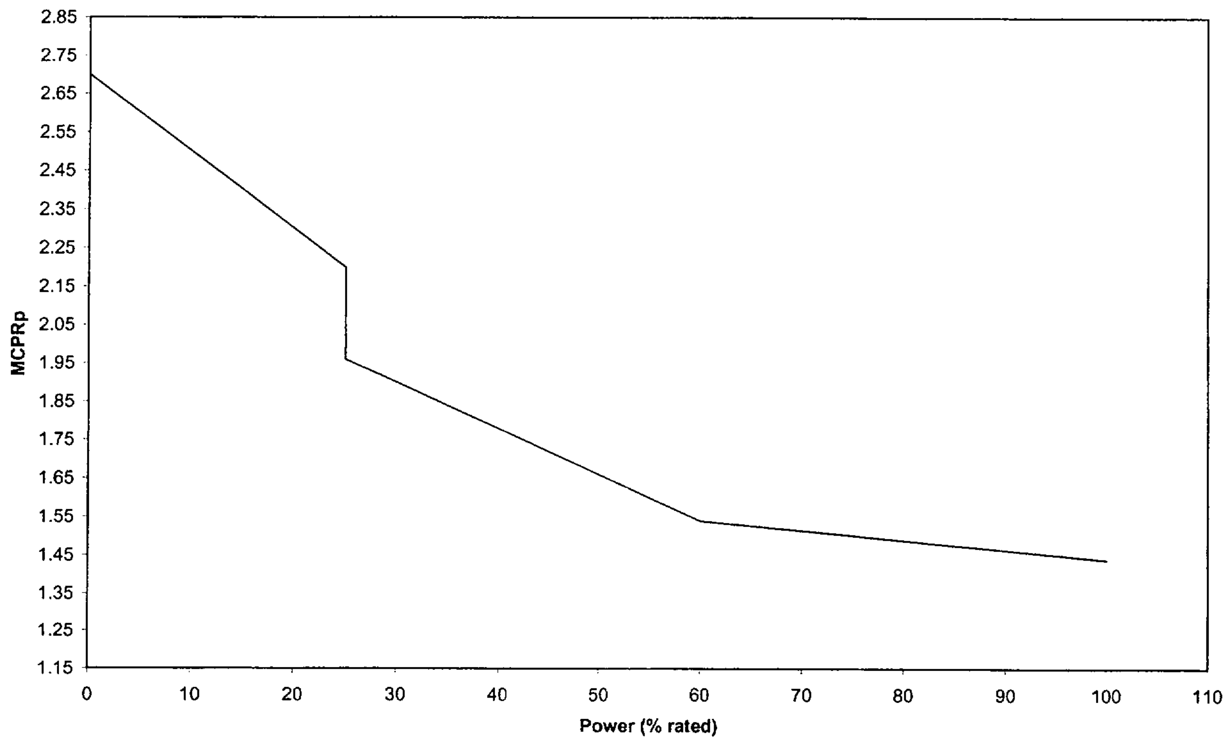
Power (%)	$MCPR_p$ Limit
100	1.43
60	1.50
25	1.95
25	2.20
0	2.70

Figure 5.8 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



Power (%)	$MCPR_p$ Limit
100	1.50
60	1.55
25	2.15
25	2.20
0	2.70

Figure 5.9 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



Power (%)	$MCPR_p$ Limit
100	1.44
60	1.54
25	1.96
25	2.20
0	2.70

Figure 5.10 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times

6.0 Postulated Accidents

6.1 *Loss-of-Coolant Accident*

6.1.1 Break Location Spectrum

References 9.9 and 9.10

6.1.2 Break Size Spectrum

References 9.9 and 9.10

6.1.3 MAPLHGR Analyses

ATRIUM-9B Fuel: The MAPLHGR limits presented in Reference 9.11 are valid for LaSalle Unit 1 ATRIUM-9B (LSA-1) fuel for Cycle 10 operation.

Limiting Break: 1.1 ft^2 Break
Recirculation Pump Discharge Line
High Pressure Core Spray Diesel Generator Single Failure

ATRIUM-10 Fuel: The MAPLHGR limits presented in Reference 9.12 are valid for LaSalle Unit 1 ATRIUM-10 (LSA-2) fuel for Cycle 10 operation.

Limiting Break: 1.0 ft^2 Break
Recirculation Pump Suction Line
High Pressure Core Spray Diesel Generator Single Failure

The ATRIUM-9B PCT results reported in Reference 9.13 remain applicable for Cycle 10. The ATRIUM-9B MAPLHGR limits have been extended to a planar exposure of 64.3 GWd/MTU as shown in Section 7.2.1. The ATRIUM-10 PCT results reported in Reference 9.12 are applicable for Cycle 10. The LOCA/heatup analysis results for LaSalle Unit 1 Cycle 10 are presented below (References 9.12 and 9.13). (Note that the MCPR value used in the LOCA analyses for both ATRIUM-10 and ATRIUM-9B fuel is less than the rated power MCPR limits presented in Section 5.0.)

	Maximum PCT (°F)	Peak Local Metal-Water Reaction (%)
ATRIUM-9B Fuel	1827	0.79*
ATRIUM-10 Fuel	1807	0.69

The maximum core wide metal-water reaction for both ATRIUM-10 and ATRIUM-9B fuel is <0.16%.

* The peak local metal water reaction result is consistent with the limiting PCT analysis results reported in Reference 9.13.

6.2 *Control Rod Drop Accident*

LaSalle is a banked position withdrawal sequence (BPWS) plant. In order to allow the site the option of inserting control rods using the simplified shutdown control rod sequences shown in Figures 6.1 and 6.2, a CRDA was performed for the simplified sequences. The results from these simplified sequence analyses (one each for operating in A2 or A1 sequence), bound those where BPWS guidelines are followed.

The CRDA analysis demonstrate that the maximum deposited fuel rod enthalpy is less than the NRC limit of 280 cal/g and that the predicted number of fuel rods which exceed the damage threshold of 170 cal/gm is less than 850 for FRA-ANP fuel and 770 for GE fuel (in LaSalle UFSAR Chapter 15 radiological assessment).

Maximum Dropped Control Rod Worth, %Δk	1.12
Doppler Coefficient, Δk/k/°F	-10E-6
Effective Delayed Neutron Fraction	0.00543
Four-Bundle Local Peaking Factor	1.35
Maximum Deposited Fuel Rod Enthalpy, cal/gm	203
Number of Rods Greater than 170 cal/g	286

Table 6.1 Simplified Shutdown Sequence from an A1 Rod Pattern

Rod Group	Insertion	Comment
7 or 8	48-00	Either group 7 or 8 may be inserted first.
10	48-00	Groups 7 and 8 must be fully inserted prior to inserting any Group 10 rod.
9	48-00	Group 10 must be fully inserted prior to inserting any Group 9 rod.
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	48-00	Group 4 must be fully inserted prior to inserting any Group 3 rod.
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.

Table 6.2 Simplified Shutdown Sequence from an A2 Rod Pattern

Rod Group	Insertion	Comment
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	48-00	Group 8 must be fully inserted prior to inserting any Group 7 rod.
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	48-00	Group 4 must be fully inserted prior to inserting any Group 3 rod.
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.

7.0 Technical Specifications

7.1 *Limiting Safety System Settings*

7.1.1 MCPR Fuel Cladding Integrity Safety Limit

MCPR Safety Limit (all fuel) - two-loop operation 1.11*
MCPR Safety Limit (all fuel) - single-loop operation 1.12*

7.1.2 Steam Dome Pressure Safety Limit

Pressure Safety Limit 1325 psig

7.2 *Limiting Conditions for Operation*

7.2.1 Average Planar Linear Heat Generation Rate

References 9.11, 9.12 and 9.16

ATRIUM-10 Fuel MAPLHGR Limits		ATRIUM-9B Fuel MAPLHGR Limits	
Average Planar Exposure (GWd/MTU)	MAPLHGR (kW/ft)	Average Planar Exposure (GWd/MTU)	MAPLHGR (kW/ft)
0.0	12.5	0.0	13.5
15.0	12.5	20.0	13.5
55.0	9.1	64.3†	9.07
64.0	7.6		

GE9 Fuel
MAPLHGR Limits

< To be furnished by Exelon. >

Single Loop Operation MAPLHGR Multiplier for ATRIUM-10 and ATRIUM-9B Fuel is 0.90

References 9.11 and 9.12

* Includes the effects of channel bow, up to 2 TIPOOS (or the equivalent number of TIP channels), a 2500 EFPH LPRM calibration interval, cycle startup with uncalibrated LPRMs (BOC to 500 MWd/MTU) and up to 50% of the LPRMs out of service.

† Exposure extended to 64.3 GWd/MTU to support exposure extension for ATRIUM-9B fuel presented in Reference 9.14.

7.2.2 Minimum Critical Power Ratio

Flow Dependent MCPR Limits:

Manual Flow Control	Figure 5.1

Power Dependent MCPR Limits:

Base Case Operation - NSS Insertion Times	Figures 5.3, 5.4, 5.7 and 5.8
Base Case Operation - TSSS Insertion Times	Figures 5.5, 5.6, 5.9 and 5.10
EOD and EOOS Operation	Tables 5.1–5.4

7.2.3 Linear Heat Generation Rate

References 9.2 and 9.14

ATRIUM-10 Fuel Steady-State LHGR Limits		ATRIUM-9B Fuel Steady-State LHGR Limits	
Average Planar Exposure (GWd/MTU)	LHGR (kW/ft)	Average Planar Exposure (GWd/MTU)	LHGR (kW/ft)
0.0	13.4	0.0	14.4
15.0	13.4	15.0	14.4
55.0	9.1	64.3	7.9
64.0	7.3		

GE9 Fuel
Steady-State LHGR Limits

< To be furnished by Exelon. >

The protection against power transient (PAPT) linear heat generation rate curves for ATRIUM-10 and ATRIUM-9B fuel are identified in References 9.2 and 9.14, respectively.

ATRIUM-10 Fuel PAPT LHGR Limits		ATRIUM-9B Fuel PAPT LHGR Limits	
Average Planar Exposure (GWd/MTU)	LHGR (kW/ft)	Average Planar Exposure (GWd/MTU)	LHGR (kW/ft)
0.0	18.1	0.0	19.4
15.0	18.1	15.0	19.4
55.0	12.2	64.3	10.6
64.0	9.8	--	--

$LHGRFAC_f$ and $LHGRFAC_p$ multipliers are applied directly to the steady-state LHGR limits at reduced power, reduced flow and/or EOD/EOOS conditions to ensure the PAPT LHGR limits are not violated during an AOO.

LHGRFAC Multipliers for Off-Rated Conditions – ATRIUM-10 and ATRIUM-9B Fuel:

$LHGRFAC_f$	Figure 5.2
$LHGRFAC_p$	Tables 5.1–5.4

MAPFAC Multipliers for Off-Rated Conditions - GE9 Fuel:

$MAPFAC_f$	< To be furnished by Exelon. >
$MAPFAC_p$	< To be furnished by Exelon. >

8.0 Methodology References

See XN-NF-80-19(P)(A) Volume 4 Revision 1 for a complete bibliography.

8.1 ANF-913(P)(A) Volume 1 Revision 1 and Volume 1 Supplements 2, 3 and 4, *COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses*, Advanced Nuclear Fuels Corporation, August 1990.

8.2 ANF-524(P)(A) Revision 2 and Supplements 1 and 2, *ANF Critical Power Methodology for Boiling Water Reactors*, Advanced Nuclear Fuels Corporation, November 1990.

8.3 ANF-1125(P)(A) and ANF-1125(P)(A), Supplements 1 and 2, *ANFB Critical Power Correlation*, Advanced Nuclear Fuels Corporation, April 1990.

8.4 EMF-1125(P)(A) Supplement 1 Appendix C, *ANFB Critical Power Correlation Application for Co-Resident Fuel*, Siemens Power Corporation, August 1997.

8.5 ANF-1125(P)(A) Supplement 1 Appendix E, *ANFB Critical Power Correlation Determination of ATRIUM™-9B Additive Constant Uncertainties*, Siemens Power Corporation, September 1998.

8.6 EMF-2209(P)(A) Revision 1, *SPCB Critical Power Correlation*, Siemens Power Corporation, July 2000.

8.7 XN-NF-80-19(P)(A) Volume 1 Supplement 3, Supplement 3 Appendix F, and Supplement 4, *Advanced Nuclear Fuels Methodology for Boiling Water Reactors: Benchmark Results for CASMO-3G/MICROBURN-B Calculation Methodology*, Advanced Nuclear Fuels Corporation, November 1990.

8.8 EMF-CC-074(P) Volume 4 Revision 0, *BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2*, Siemens Power Corporation, August 2000.

9.0 Additional References

9.1 EMF-2624(P) Revision 1, *Neutronic Design LaSalle Unit 1 Cycle 10 ATRIUM™-10 Fuel*, Framatome ANP, Inc., September 2001.

9.2 EMF-2589(P) Revision 0, *Mechanical and Thermal-Hydraulic Design Report for LaSalle Units 1 and 2 ATRIUM™-10 Fuel Assemblies*, Framatome ANP, Inc., July 2001.

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

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9.6 EMF-2556(P) Revision 0, *Criticality Safety Analysis for ATRIUM™-10 Fuel, LaSalle Unit 1 Spent Fuel Storage Pool (BORAL Rack)*, Framatome ANP, Inc., September 2001.

9.7 EMF-2650(P) Revision 0, *Criticality Safety Analysis for ATRIUM™-10 Fuel, LaSalle Unit 2 Spent Fuel Storage Pool (Boraflex Rack)*, Framatome ANP, Inc., November 2001.

9.8 Letter, D. E. Garber (FRA-ANP) to F. W. Trikur (Exelon), "Disposition of Events Summary for the Introduction of ATRIUM-10™-10 Fuel at LaSalle County Station," DEG:01:179, October 30, 2001.

9.9 EMF-2174(P), *LOCA Break Spectrum Analysis for LaSalle Units 1 and 2*, Siemens Power Corporation, March 1999.

9.10 EMF-2639(P) Revision 0, *LaSalle Units 1 and 2 LOCA Break Spectrum Analysis for ATRIUM™-10 Fuel*, Framatome ANP, Inc., November 2001.

9.11 EMF-2175(P), *LaSalle LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™-9B Fuel*, Siemens Power Corporation, March 1999.

9.12 EMF-2641(P) Revision 0, *LaSalle Units 1 and 2 LOCA-ECCS Analysis MAPLHGR Limit for ATRIUM™-10 Fuel,* Framatome ANP, Inc., November 2001.

9.13 Letter, D. E. Garber (SPC) to F. W. Trikur (Exelon), "Transmittal of 10 CFR 50.46 Reporting for LaSalle Units, Condition Report 9008, and CMR 2156," DEG:01:108, July 17, 2001.

9.14 EMF-2563(P) Revision 1, *Fuel Mechanical Design Report Exposure Extension for ATRIUM™-9B Fuel Assemblies at Dresden, Quad Cities, and LaSalle Units*, Framatome ANP, Inc., August 2001.

9.15 Correspondence, S. A. Richards (NRC) to J. F. Mallay (SPC), "Supplement to Safety Evaluation and Technical Evaluation Report Clarifications for EMF-CC-074(P) Volume 4 Revision 0, BWR Stability Assessment for STAIF with Input from MICROBURN-B2," November 30, 2000.

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Attachment 3

LaSalle Unit 1 Cycle 10A

Plant Transient Analysis

FRAMATOME ANP

EMF-2689
Revision 0

LaSalle Unit 1 Cycle 10
Plant Transient Analysis

January 2002

Framatome ANP, Inc.

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